

**Course Structure for the Undergraduate Studies
Department of Chemical and Food Process Engineering**

Summary of Courses for the B. Sc. Engineering 1st Year

1st Year Odd Semester

SL. No.	Course No.	Course Title	Contact hours/ Week	Credits
Theory Courses				
1.	Chem 1105	Chemistry-I	3.00	3.00
2.	Phy 1105	Physics	3.00	3.00
3.	Hum 1105	Economics and Sociology	3.00	3.00
4.	Math 1105	Differential Calculus and Geometry	3.00	3.00
5.	CFPE 1101	Introduction to Chemical Engineering	3.00	3.00
Sessional Courses				
6.	Chem 1106	Chemistry-I Sessional	1.50	0.75
7.	Phy 1106	Physics Sessional	3.00	1.50
8.	ME 1120	Engineering Drawing	3.00	1.50
9.	MES 1126	Workshop Practice	3.00	1.50
Total			25.50	20.25

1st Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
Theory Courses				
1.	Chem 1205	Chemistry-II	3.00	3.00
2.	Hum 1205	Technical English	3.00	3.00

3.	Math 1205	Integral Calculus and Differential Equation	3.00	3.00
4.	EEE 1233	Electrical Circuits	3.00	3.00
5.	CFPE 1203	Introduction to Food Process Engineering	3.00	3.00
Sessional Courses				
6.	Chem 1206	Chemistry-II Sessional	1.50	0.75
7.	Hum 1206	Technical English Sessional	2.00	1.00
8.	EEE 1234	Electrical Circuits Sessional	3.00	1.50
9.	CFPE 1204	Introduction to Chemical and Food Process Engineering Sessional	3.00	1.50
Total			24.50	19.75

Detail Syllabus of the B.Sc. Engineering 1st Year Odd Semester

Chem 1105 (Chemistry-I)

Lecture: 3 hrs/week,

No. of credit: 3.00

Physical Chemistry: Types of solution; measuring composition; solubility; Henry's law; distribution law; dilute solution and colligative properties; colloids and colloidal solution. Thermo-chemistry; chemical equilibrium; chemical kinetics, photochemical kinetics, Electrolytic conduction; electrical properties of solution; interionic attraction theory; electrochemical cells; cell emf; thermodynamics of electrochemical cells; application of emf measurements; ionic equilibria; buffer solution; Henderson equation and its application; pH scale and corrosion.

Inorganic Chemistry: Modern concept of atomic structure; periodic table and its application; isotopes and application of radioactive isotopes; brief discussion on noble gas; different types of chemical bonds, Electronic concepts of chemical bonds; hybridization; theories of coordination compounds; application of stability of complex compounds; modern theories of acids and bases; acid-base titration; complexometric titration.

Chem 1106 (Chemistry-I Sessional)

Sessional: 1.5 hrs/Week,

No. of Credit: 0.75

Sessional based on Chemistry-I

Phy 1105 (Physics)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Modern Physics: Review of quantum concepts: particle nature of light, photoelectric effect, Compton effect, matter waves, wave packets, phase and group velocity, Davisson Germer experiment, Heisenberg uncertainty principle. Schrodinger equation: probabilistic interpretation of wave function, one dimensional problems particle in a box, harmonic oscillator, potential barrier and tunneling. Hydrogen atom, electrons in a magnetic field, Landau levels

Structure of Matter: States of matter: solid, liquid and gas. Classification of solids: amorphous, crystalline, ceramics and polymers. Atomic arrangement in solids. Different types of bonds in solids: metallic, Vander walls, covalent and ionic bond, packing in solids, interatomic distance and forces of equilibrium, X-ray diffraction. Bragg's law. Plasticity and elasticity. Distinction between metal, insulator and semi-conductor.

Electricity and Magnetism: Electric charge, Coulomb's law, the electric field: calculation of the electric field strength electric dipole, calculation of electric flux and Gauss's law, some applications of Gauss's law; electric potential V, relation between E and V, electric potential energy; capacitors; capacitance, dielectrics and atomic view, dielectrics and Gauss' law. current and resistance; current and current density, Ohm's law resistivity an atomic view, Ampere's law, Faraday's law, Lenz's law, self-inductance and mutual inductance; magnetic properties of matter; magneto motive force, magnetic field intensity, permeability, susceptibility, classifications of magnetic materials, magnetization curves.

Phy 1106 (Physics Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Physics

Hum 1105 (Economics and Sociology)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Economics:

Fundamental Concept of Economics: Definition of economics, economics and engineering; microeconomics and macroeconomics; economic theories: application of economic theories to the problems of developing countries; marginal analysis, demand and supply; elasticity; price system; market and equilibrium; money; inflation; concept of inflation, causes, consequences and remedies; payback period, NVP, IRR, price index number; consumer price index; laws of returns; economics and diseconomies; theory of production: production function; small scale production and large scale production, productivity types, equilibrium of firm.

Gross National Product (GNP) and National Income: Concepts, measurements and importance of national income in the modern economics; economic growth and development: national income relationship; economic planning; development problems in Bangladesh; the role of the state in economic activity, market and government failures.

International Trade: Terms of trade, free trade and trade protection; tariffs & quotas.

Sociology:

Definition, relationship with other social sciences, subject matter, scope; social system- family, marriage, economic, political & recreational institutions; role of Engineers in society, urban community, urban ecology, rural and urban power structure.

Social Problems: Social problems as the outcome of industrialization, unemployed delinquency and crime; effects of change in science & technology on society, social crime, cyber-crime; deviant behavior, relationship between culture and civilization.

Math 1105 (Differential Calculus and Geometry)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Differential Calculus: Limit, continuity, differentiation and successive differentiation of various type of functions, Leibnitz's theorem, expansion of function, Rolle's theorem, mean value theorem, Taylor's series, partial differentiation, determination of maximum and minimum values of functions and their applications, indeterminate forms, L'Hospital rule, curvature. Application of

differential calculus to solve practical problems in Mechanical Engineering.

Two Dimensional Coordinate Geometry: Coordinate geometry of two dimensions, change of axes, pair of straight line, general equation of second degree, circle, parabola, ellipse.

Three Dimensional Coordinate Geometry: Coordinate geometry of three dimensions, system of coordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines.

CPFE 1101 (Introduction to Chemical Engineering)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Historical overview of Chemical Engineering: Concepts of unit operations and unit processes, and more recent developments.

Chemical Industry: Scope, features, characteristics and overview of polymers, petroleum & petrochemical industries, fertilizer, pulp and paper industries, glass, ceramic and cement industries, pyrolysis oil industry. Material and energy balances in simple systems involving physical changes and chemical reactions; systems involving recycle, purge and bypass.

Properties of substances: Single component & multicomponent, single and multiphase systems. Use of Compressibility charts, vapor pressure correlations/charts & Psychometric charts. Ideal liquid and gaseous mixtures. Case study on the chemical industry in Bangladesh.

ME 1120 (Engineering Drawing)

Sessional: 3 hrs/week,

No. of Credit: 1.50

The Graphic Language: Introduction to pictorial drawing, lettering, theory of projection, orthographic projection, first and third angle projection; drawing equipment & use of instruments, size description, scale, dimensioning rules; multi view representation and conventional practices, graphical mathematics, geometrical construction.

Engineering Drawing: Introduction to factory building drawing.

MES 1126 (Workshop Practice)

Sessional: 3 hrs/week,

No. of Credit: 1.5

Introduction to wood work: Hand tools & various operations; pattern making: types of patterns, allowances, color coding. etc.; bench work & fitting: tools & operations; metal cutting and machine tools; safety measures; principles of operation of

basic machine tools like lathe, shaping, & drilling; important operations on these machines; cutting tools and their usage, selection of cutting speeds, feeds, etc.; Welding, brazing and soldering. Practical assignments in wood work, fitting, lathe and shaping machine and arc welding.

Detail Syllabus of the B.Sc. Engineering 1st Year Even Semester

Chem 1205 (Chemistry-II)

Lecture: 3 hrs/week,

No. of credit: 3.00

Aliphatic and Aromatic Compounds: The hybridization of carbon atom and covalent bonding. A comprehensive study of aliphatic hydrocarbons with special reference to nomenclatures, method of preparation, properties and important uses. Types of reactions of aliphatic hydrocarbons and their industrial applications. Structure, nomenclature, preparation, properties, reactions and industrial applications of aliphatic hydrocarbon homologues. Aromatic compounds and aromaticity; preparation, properties, reactions and industrial applications of benzene and its derivatives. Heterocyclic compounds and their applications.

Organic Reaction Mechanism: Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions.

Stereochemistry of Carbon Compounds: Selected Organic Compounds: Natural products and Biomolecules (Amino acids/nucleic acids/proteins).

Chem 1206 (Chemistry-II Sessional)

Session: 1.5 hrs/week,

No. of Credit: 0.75

Sessional based on Chemistry-II

Hum 1205 (Technical English)

Lecture: 3 hrs/week,

No of Credit: 3.00

Grammar: Properties of English grammar, IPA, correction. Construction of sentences.

Vocabulary: Scientific terms, phrases and idioms, group verb, prepositional phrases.

Reading Comprehension: Techniques of reading, skimming, scanning, SQ3R technique.

Writing: Formal letter, resume, paragraph, report writing, tender and schedule, APA style sheet, email writing. Commercial correspondence and tenders, amplification, précis writing.

Modern Literature: At least three short stories and three poems.

Hum 1206 (Technical English Sessional)

Lecture: 2 hrs/week,

No of Credit: 1.00

Listening: Monologue, conversation (formal and informal), telephoning and direction; note taking skills.

Speaking: Basic conversation, job interview, seminar and paper presentation; formal speech, telephoning, difference between British and American English.

Math 1205 (Integral Calculus and Differential Equation)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Integral Calculus: Review of elementary techniques (integration by the method of substitution, integration by parts, successive reduction, and standard integrals), improper integrals, beta, gamma and error function, differentiate inside integral, definite integrals, multiple integrals, area, surface area and volume of solids of revolution.

Differential equation: Degree and order of differential equations; solution of first order ordinary differential equation by various methods; solution of linear differential equations of second degree and higher orders with constant coefficients; solution of higher order differential equations when the dependent and independent variables are absent; solution of ordinary differential equations by the method of factorization of the operator, applications.

EEE 1233 (Electrical Circuits)

Lecture: 3 hrs/week

No. of Credit: 3.00

Electrical Circuits: Network laws and theorems, methods of analysis; electrical field concepts: capacitance; transient and steady state analyses of electrical networks for different forcing functions; introduction to magnetic circuits; effective and average values of alternating waveforms; phasor and complex-impedance; steady state analysis of AC networks; balanced polyphase systems.

EEE 1234 (Electrical Circuits Sessional)

Sessional: 3 hrs/week

No. of Credit: 1.50

Sessional based on Electrical Circuits.

CFPE 1203 (Introduction to Food Process Engineering)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Modern development of food processing Engineering: Concepts of unit operations and unit processes, and more recent developments.

Application of engineering technology to food processing: Dairy processing, poultry and meat processing, fruit and vegetable processing, cereals, pulse and oilseed processing; seafood processing and other specific food sectors strategic to Bangladesh.

Study of main food processing operations: Heating and thermal processing, cooling, freezing and thawing, evaporation, dehydration, the use of membranes and packaging.

Flow sheeting Basics, types of diagrams, Material and Energy Balances. Overview of key food properties, introduction of concept of unit operations. Case study on the Food Industries in Bangladesh.

CFPE 1204 (Introduction to Food Process Engineering Sessional)

Sessional: 3 hrs/week

No. of Credit: 1.50

Sessional based on Introduction to Food Process Engineering

Courses of the B.Sc. in Chemical and Food Process Engineering 2nd Year

2nd Year Odd Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
Theory Courses				
1.	Math 2129	Vector Analysis, Matrices and Laplace Transforms	3.00	3.00
2.	CFPE 2101	Chemical Thermodynamics	3.00	3.00
3.	ME 2123	Engineering Mechanics	3.00	3.00
4.	ME 2125	Heat Transfer	3.00	3.00
5.	EEE 2133	Electrical Machines and Electronics	3.00	3.00
Sessional Courses				
6.	CFPE 2102	Chemical Thermodynamics Sessional	3.00	1.50
7.	ME 2126	Heat Transfer Sessional	3.00	1.50
8.	EEE 2134	Electrical Machines and Electronics Sessional	3.00	1.50
Total			24.00	19.50

2nd Year Even Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
Theory Courses				
1.	Math 2229	Numerical Analysis and Statistics	3.00	3.00
2.	CFPE 2201	Principles of Food Processing & Preservation	3.00	3.00
3.	ME 2227	Fluid Mechanics	3.00	3.00
4.	ME 2229	Solid Mechanics	3.00	3.00
5.	CSE 2241	Computer Programming and	3.00	3.00

		Applications		
Sessional Courses				
6.	Math 2230	Numerical Analysis and Statistics Sessional	3.00	1.50
7.	ME 2228	Fluid Mechanics Sessional	3.00	1.50
8.	ME 2230	Solid Mechanics Sessional	1.50	0.75
9.	CSE 2442	Computer Programming and Applications Sessional	3.00	1.50
Total			25.50	20.25

Detail Syllabus of 2nd Year Odd Semester B.Sc. in Chemical and Food Process Engineering

Math 2129 (Vector Analysis, Matrices and Laplace Transforms)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Vector Analysis: Linear dependence and independence of vectors, vector geometry, differentiation and integration of vectors with respect to a parameter, line, surface and volume integrations, gradient of a scalar function, divergence and curl of a vector and its physical significance, conservative system, Green's theorem, Gauss's divergence theorem, Stoke's theorem and their applications in physical problems.

Matrices: Different types of matrices, ranks, adjoint and inverse, elementary transformation. Determination of eigen value and eigen vectors, Solution of system of linear equations by matrix methods.

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.

CFPE 2101 (Chemical Thermodynamics)

Lecture: 3 hrs/week,

No. of

Credit: 3.00

Fundamental Concept of Thermodynamics: Basic concepts and definitions; thermodynamic systems, property and state, thermodynamic process and cycle.

Laws of Thermodynamics: First law of thermodynamics and its corollaries, first law applied to open and closed system; second law of thermodynamics and its corollaries; statement of third law of thermodynamics; Zeroth law, thermal equilibrium; reversibility, irreversibility, enthalpy, entropy and internal energy.

Thermodynamic Cycles: Air standard power cycles, air standard refrigeration cycles, PV and TS diagrams.

Introduction to IC Engines: Diesel engine and petrol engine; two and four stroke engines; operations; valve timing diagram.

Study of Steam Generating Unit: Introduction, operation of modern steam boilers, accessories and mountings; performance study of steam generator.

Solution Thermodynamics: Relationships among the thermodynamic properties for systems of variable composition; partial molar properties; fugacity and fugacity coefficients; fugacities in ideal solutions; heat effects of mixing processes. Phase equilibria; nature and criteria of equilibrium; Duhem's theorem; vapor-liquid equilibrium calculations for miscible systems; Gibbs-Duhem equation.

ME 2102 (Chemical Thermodynamics Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Thermodynamics

ME 2123 (Engineering Mechanics)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Force systems: Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple.

Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses.

Friction: Laws of Coulomb friction, problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance.

Properties of areas: Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia.

Principle of Virtual Work; Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion.

Rigid Body Dynamics: Relative velocity, Translation, Pure rotation and plane motion of rigid bodies, D'Alembert's principle, linear momentum, principle of conservation of momentum, Impact of solid bodies, work, energy, power, principle of conservation of energy

ME 2125 (Heat Transfer)

Lecture: 3 hrs/week,

No. of Credit:

3.00

Modes of heat transfer: Conduction: mechanism of thermal conduction in solids, liquids and gases; other thermal properties; steady state heat conduction in one dimension; transient heat conduction. The basic equation of momentum and heat transport. Some approximate solutions of convection heat transfer. Dimensionless correlations for forced and free convection. Heat transfer with phase change: boiling and condensation. Thermal radiation: black body radiation; exchange between infinite and finite surfaces indifferent enclosures.

Types of heat transfer equipment: Design of heat exchangers; mean temperature difference in different flow arrangements; thermal and mechanical design; materials of construction. Extended surfaces.

ME 2126 (Heat Transfer Sessional)

Sessional: 3 hrs/week,

No. of Credit:

1.50

Sessional based on Heat Transfer

EEE 2133 (Electrical Machines and Electronics)

Lecture: 3hrs/week

No. of Credit

3.00

Transformers: Single phase and three phases; open and short-circuit tests.

Electrical Machines:

DC machines: DC generator and motors; speed control and applications of DC motor.

AC Machines: Synchronous and asynchronous machines; speed control and applications; starting of motors.

Introduction to Semiconductor Devices: Diode, transistors, FET, amplifiers and their applications. Introduction to silicon controlled rectifier and its application; oscilloscope; logic circuits; A/D and D/A conversion.

EEE 2134 (Electrical Machines and Electronics Sessional)

Sessional: 3hrs/week

No. of Credit: 1.50

Sessional based on Electrical Machine and Electronics.

Detail Syllabus of the B.Sc. in Chemical and Food Process

Engineering 2nd Year Even Semester

Math 2229 (Numerical Analysis and Statistics)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Numerical Analysis: Interpolation with equal and unequal intervals, central difference formulae, trapezoidal and Simpson's rule; solution of algebraic and transcendental equations; Bisection and Regula falsi method, initial approximation and convergence criteria of iteration method, Newton-Raphson method, solution of simultaneous linear algebraic equations, Gauss elimination method, Gauss Jordan method, Jacobi method, Gauss Seidal method.

Numerical Solution of Ordinary and Partial Differential Equations: Euler's and Runge-Kutta method; finite difference method.

Application of Numerical Analysis in Chemical and Food Process Engineering problems.

Statistics: Basic statistics: Importance of statistics in Chemical and Food Process Engineering; Frequency distribution; Review of central tendency and dispersion; moments, skewness and kurtosis; variables and attributes, sources of variation in process control, chance and assignable variation; correlation and regression; elementary probability and probability distributions (e.g. Binomial, Poisson and Normal distributions).

Process Capability: Process capability index; sampling basics and sampling risks

Control Charts: Basic and types of control charts; shewhart control chart; construction of mean, range and standard deviation charts; rules for interpreting control charts, Average Run Length(ARL) of process control.

Math 2230 (Numerical Analysis and Statistics Sessional)

Sessional: 3 hrs/week

No. of Credit: 1.50

Sessional based on Numerical Analysis.

CFPE 2203 (Principles of Food Processing & Preservation)

Lecture: 3 hrs/week,

No. of Credit:

3.00

Introduction: Definition and scope of Food Science and Technology, historical development of food processing and preservation, general principles of food preservation.

Preservation of food by low temperatures: Chilling: Considerations relating to storage of foods at chilling temperature, applications and procedures, controlled and modified atmosphere storage of foods. Freezing temperature: Freezing process, slow and fast freezing of foods and its consequences, other occurrences associated with freezing of foods. Technological aspects of prefreezing, Actual freezing, frozen storage and thawing of foods.

Preservation of foods by high temperature: Basic concepts in thermal destruction of microorganisms-D, Z, F, values Heat resistance and thermophilisms in micro-organisms. Cooking, blanching, pasteurization and sterilization of foods. Extrusion, baking, roasting, frying, dielectric heating, ohmic, microwave and infrared heating. Assessing adequacy of thermal processing of foods, general process of canning of foods, spoilages in canned foods.

Preservation by water removal: Sun drying of various foods, water activity and its effect on the keeping quality, sorption isotherms and their use. Characteristics of food substances related to their dehydration behavior, drying phenomenon, factors affecting rate of drying, methods of drying of various food products, type of driers and their suitability for different foods;

intermediate moisture foods.

Radiations: Sources of radiations, units and doses, effect on microorganisms and different nutrients; dose requirements for radiation preservation of foods, safe limits, irradiation mechanism and survival curve, irradiation of packaging materials.

Chemical Preservations: Principles, technological aspects and applications of sugar and salt, antimicrobial agents, biological agent, Hurdle technology. Effects of various food processing operations on the nutritive value of foods.

ME 2227 (Fluid Mechanics)

**Lecture: 3 hrs/week,
3.00**

No. of Credit:

Definition and properties of fluids: Units of measurements; fluid statics, pressure at a point and its measurement; fluids static force on submerged surfaces, buoyancy, condition of floatation and stability of submerged and floating bodies.

Kinematics of fluids: Lagrangian and Eulerian description of fluid motion, stream lines, path lines, streak lines, types of fluid flow: translation, rotation, circulation and vorticity stream function, velocity potential and flow net; discharge: system, control volume and cross section; stress-strain rate relationship, linear and angular momentum theorems and applications; some exact solutions of Navier-Stokes equations.

Dynamics of fluid: transport theorem, conservation laws, equation of continuity, Euler's equation of motion, Bernoulli's equation, viscous flow. Raleigh's method and Buckingham's π theorem, types of similarities, dimensional analysis, dimensionless numbers.

Internal flow: laminar and turbulent flow in pipes, general equation for head loss – DarcyWeisbach and Fanning's equations, Moody's diagram, energy losses through pipe fittings, flow through network of pipes.

Boundary layer flows-Introduction, Prandtl's boundary layer equation and **Boundary layer separation:** Flow around submerged bodies: Drag force, lift and drag coefficient, drag on flat plate circular cylinder and sphere.

Flow Measurements and pumps: Orifice and venturi meter, Pitot tube, Rotameter and other flow measuring instruments, Positive displacement and centrifugal pumps.

ME 2228 (Fluid Mechanics Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Fluid Mechanics

ME 2229 (Solid Mechanics)

**Lecture: 3 hrs/week,
3.00**

No. of Credit:

Rigid and deformable solids; Method of sections for evaluating internal forces in bodies - review of free body diagrams; Concept of stress - normal and shear stresses; State of stress; Concept of strain - normal and shear strains; State of strain; Hookes law; Constitutive relations; Axially loaded members, force and deflections; Indeterminate systems and compatibility conditions; Simple indeterminate systems and lack of fit problems; Generalized Hookes law; Stress in cylindrical and spherical shells; Thin-Walled Pressure Vessels; Torsion of circular shafts - determinate and simple indeterminate systems. Elastic theory of bending of beams; Shear force and bending moment diagrams; Bending and shearing stresses in beams of symmetrical cross-section; Concept of shear flow and shear centre; Principle of superposition and its limitations. Transformation of plane stress and strain; Principal stresses and strains; Mohrs circle. Bending deflection of beams by direct integration method; Application of direct integration method to simple indeterminate systems. Elastic buckling of compression members.

ME 2230 (Solid Mechanics Sessional)

**Lecture: 1.5 hrs/week,
0.75**

No. of Credit:

Sessional based on Solid Mechanics

CSE 2241 (Computer Programming and Applications)

**Lecture: 3 hrs/week,
3.00**

No. of Credit:

Introduction: Main parts like I/O devices, Memory unit and CPU. Primary and

secondary storage devices, different memory types. Introduction to number systems. Overview of DOS, Windows and UNIX operating systems, Essential general purpose packages for word processing, spreadsheet analysis etc.

Languages: Development of programming logic, algorithm, flow chart; Assembly level language and Machine level language, high level language, Compiler, Interpreter, Source and Object programs.

Concept of Algorithms: Development of Flowcharts to solve engineering problems.

Introduction to C & C++ Language: Preliminaries, Program construction and data types, I/O statements, Expressions, Decision making, Loops, Function and its Calling procedure, Recursion, Arrays and pointer, structure aduminar, Application of computer programming for solving mechanical engineering problems.

CSE 2242 (Computer Programming and Applications Sessional)

Lecture: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Computer Programming and Applications

Courses of the 3rd Year B.Sc. Engineering

3rd Year Odd Semester

SL. No.	Course No.	Course Title	Contact Hours/ Week	Credits
Theory Courses				
1.	CFPE 3101	Chemical Reaction Engineering	3.00	3.00
2.	CFPE 3103	Food Chemistry	3.00	3.00
3.	CFPE 3105	Mechanical Operations in Food	3.00	3.00

		Processing		
4.	CFPE 3107	Food Process Technology-I	3.00	3.00
5.	CFPE 3109	Mass Transfer Operations	3.00	3.00
Sessional Courses				
6.	CFPE 3104	Food Chemistry Sessional	1.50	0.75
7.	CFPE 3106	Mechanical Operations in Food Processing Sessional	3.00	1.50
8.	CFPE 3108	Food Process Technology-I Sessional	3.00	1.50
9.	CFPE 3100	Industrial Training	4 Weeks	1.00
Total			22.50	19.75

3rd Year Even Semester

SL. No	Course No.	Course Title	Contact Hours/ Week	Credits
Theory Courses				
1.	Hum 3205	Accounts and Industrial Law	3.00	3.00
2.	CFPE 3203	Food Microbiology	3.00	3.00
3.	CFPE 3201	Material Science	3.00	3.00
4.	CFPE 3207	Food Process Technology-II	4.00	4.00
5.	CFPE 3209	Molecular Cell Biology	3.00	3.00
Sessional Courses				
6.	CFPE 3204	Food Microbiology Sessional	1.50	0.75
7.	CFPE 3202	Chemical Engineering Sessional	3.00	1.50
8.	CFPE 3208	Food Process Technology-II Sessional	3.00	1.50
9.	CFPE 3200	Case Study in CFPE	2.00	1.00
		Total	25.50	20.75

Detail Syllabus of the B.Sc. Engineering 3rd Year Odd Semester

CFPE 3101 (Chemical Reaction Engineering)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Reaction Kinetics: Basic concepts in chemical kinetics, kinetics of homogeneous reactions, reaction rate, order, rate constant;

Types of reactors: Batch reactors, Design + basics, kinetic constants from batch reactor data, recycle reactor, automatic reactors, ideal flow reactor; Reactor design for ideal flow reactors, heat and mass transport in reactors, isothermal, adiabatic and non-isothermal operation;

Catalysts: Catalytic rates, Reaction mechanisms; Internal/External transport in catalysts; Non-catalytic solid-gas reactions; Heterogeneous and enzymatic catalysis, including diffusion to and within catalyst particles and cells or immobilized enzymes. Stoichiometry and equilibrium to the analysis of chemical and biological systems.

CFPE 3103 (Food Chemistry)

Lecture: 3 hrs/week.

No. of Credit: 3.00

Water: Physical properties, types of water, water activity and shelf life of food, Distribution of water in various foods and moisture determination.

Carbohydrates: Nomenclature and classification, structure and chemical properties of carbohydrates- monosaccharide, disaccharides and polysaccharides (cellulose, starch, fructans, galactans, hemi-cellulose, pectic substances, carageenan); changes in carbohydrates during processing. Carbohydrates determination methods. Enzymic and non-enzymic browning

Proteins: Classification, structure and properties of proteins, Proteins from plant and animal sources. Changes in protein during processing, protein determination methods.

Lipids: Classification, structure, physical and chemical properties of fatty acids and fats. Lipids-simple and derived. Different types of fats, uses in food processing, food emulsions, fat replacers. Changes during food processing. Protein lipid interaction, Lipid Carbohydrate interaction, Lipid-Lipid interaction.

Minerals: Classification, minerals in meat, milk, plants and their interaction with other components, losses of minerals during processing, metal uptake in

canned foods.

Vitamins: Role of vitamins in food industry, effect of various processing treatments and fortification of foods. Food sources, effects of deficiency
Plant pigments: Their roles in food industry, Bitter substance and tannins.

CFPE 3104 (Food Chemistry Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Food Chemistry

CFPE 3105 (Mechanical Operations in Food Processing)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Geometrical, physical, functional and growth property of foods. Cleaning, sorting and grading of foods. Peeling, decortication, deseeding of fruits, dehulling of grains, blanching of vegetables.

Size Reduction: Principles and types of size reduction equipment, disintegration of fibrous materials. Mechanical expression of edible oil.

Mixing: Mixing of liquids and solids (powder), mixing equipments, mixing index and mixing time, Agitation and blending, types of agitators, power consumption in mixing.

Filtration: Principle and types of filtration equipments, Settling classifiers and Flotation Screening, types of screen.

Centrifugation: Principle of settling and centrifugation, devices for centrifugal separation. Membrane separation processes: Reverse osmosis, nano filtration, ultrafiltration, microfiltration, dialysis and pervaporation.

CFPE 3106 (Mechanical Operations in Food Processing Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Mechanical Operations in Food Processing

CFPE 3107 (Food Process Technology-I)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Post-harvest handling of Fresh Fruits and Vegetables: Chemical composition as living products and desirable characteristics of fruits and vegetables of processing. Role of plants growth regulators in relation to storage; physical and chemical treatment to increase the shelf-life, conditions for transportation and storage, disease and injuries during marketing, biosynthesis of flavours, biosynthesis of flavors, flavor characteristics;

Minimally processed Fruits and Vegetables: Factors affecting shelf life and the quality of minimally processed fruits and vegetables, physiology and biochemistry of fresh cut.

Storage of Fresh Fruits and Vegetables: Containers: Tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control.

Processing of Fruits and vegetable: Preparation of juice, syrups, squashes, cordials, and nectars; concentrations and drying of juice, packaging, storage, concentrations and powders; fortified soft drinks, tomato product and its quality control, Vinegar production and its uses and quality control

Food additives: Use in fruit and vegetable preservation.

Cereals: Structure, types, composition, quality characteristics and physicochemical properties of rice, wheat and other cereals. Cleaning, tempering and conditioning, and milling processes for different wheat's and other cereals. Blending of flours. Milling equipments and milling products, Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria in and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice.

Cereal Malts: basic malting process, malting plant, malt storage, malt characteristics, malt extract, uses

Pulses: Pulses production, types, chemical composition, toxic factors, milling of pulses, milling equipments, factors affecting pulses quality, secondary processing of pulses, processed products, fermented products, traditional products, by products utilization; effect of processing on nutritive value.

Oilseeds: Processing of oilseeds, oil extraction methods- mechanical (ghani and expellers) and chemical methods (solvent extraction), Oil refining, processing of refined oils.

National and International quality and grading standards.

CFPE 3108 (Food Process Technology-I Sessional)

Lecture: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Food Process Technology-I

CFPE 3109 (Mass Transfer Operations)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Introduction: Introduction to mass transfer processes. Phase equilibria. Equilibrium stage concept.

Distillation: Batch distillation, continuous fractionation, calculations with multiple feeds and withdrawals; Special distillation techniques (azeotropic, extractive, etc.) steam and molecular distillation; Tray hydrodynamics and efficiencies;

Liquid-Liquid extraction: Calculations with and without reflux for immiscible and partially miscible system.

Gas absorption: Packed tower design, effect of reaction;

Simultaneous heat and mass transfer: Drying; Design of cooling towers;

Adsorption: Types and nature of adsorption; Freundlich isotherm;

Membrane processes: Gas separation processes; reverse osmosis processes.

CFPE 3100 (Industrial Training)

Sessional: 4 weeks

No. of Credit: 1.00

To be arranged in any suitable time in Second Year Even Semester/ Third Year Odd Semester

Detail Syllabus of the B.Sc. Engineering 3rd Year Even Semester

Hum 3205 (Accounts and Industrial Law)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Accounting:

Financial accounting: Definition, objectives, advantages, accounting concepts, double entry system and rules for debit and credit; transaction, capital and revenue transactions; accounts and its classification; journal, cash book,

ledger, trial balance and financial statement.

Cost Accounting: Definition, objectives, advantages, classification of cost, cost statement, overhead costing, operating costing and relevant costing; interest formula and equivalence; cash flow in engineering economy; financial and economic evaluation of a project; accounting for depreciation and income taxes; handling project uncertainty.

Industrial Law: Law of Contract: Definition, essential elements of contract, void and voidable agreement, rules regarding offer, acceptance, and consideration; methods of termination of contract.

Company Act: General principles of company law relating to formation; management and winding-up.

Labor Code 2006: Factory-definition, rules regarding employment of women, child, & adult, safety act including fire safety, benefits and privileges of employees.

Payment of Wages: Payment & deduction rules.

Trade Union Act: Definition, legal status of a registered trade union, rules of registration, cancellation of registration, rights and privileges of a registered trade union, collective bargaining process, unfair labor practice on part of both the employees and employers, penalties for unfair labor practice, industrial disputes, lockout, boycott, go-slow, strike, illegal retrenchments, layoff, methods of settlement of industrial disputes.

CFPE 3203 (Food Microbiology)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Introduction: Classification, morphology, physiology, growth, nutrition and reproduction, pure culture techniques and maintenance of cultures, control of microorganisms by physical, chemical, antibiotic and other chemotherapeutic agents

Incidence of microorganisms in foods, sources of contamination. Principles underlying spoilage and preservation of foods. Contamination, spoilage and preservation of cereal products, sugar products, fruit and vegetables, meat products, fish and sea foods, egg and poultry products, milk and milk products and other foods, microbiological standards of foods. Food borne infections, food plant sanitation, inspection and control, personnel hygiene. Advanced technologies in food microbiology: rapid method for the detection

of food borne pathogens.

Beneficial microorganisms and their utilization in food fermentation of bread, malt beverages, wines, vinegar, fermented vegetables, fermented dairy products. Probiotics and prebiotics.

CFPE 3204 (Food Microbiology Sessional)

Sessional: 1.5 hrs/week,

No. of Credit: 0.75

Sessional based on Food Microbiology

CFPE 3201 (Material Science)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Introduction: Historical perspective, Concept of engineering material and metallurgy, classification of materials.

Atomic Bonding & Crystal Structure: Atomic structure, space lattice, atomic bonding in solid, structure of crystalline solids, crystal growth, crystal system, imperfection in solids.

Phase diagram: Phase equilibrium, binary phase diagram, Fe-C System, phase transformation, Fe-C alloys.

Application and processing of metal alloys: Types of metal alloy, fabrication of metal, thermal processing of metal.

Ceramics & Glasses: Classification; structure and properties; application, fabrication and processing of ceramics & glasses.

Polymers: Type of polymer, polymer structure, characteristics of polymer, processing of polymer.

Others: Semiconductors, nanotechnology and biomaterials; Corrosion and its prevention; Environmental Effects.

CFPE 3202 (Chemical Engineering Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Chemical Reaction Engineering, Mass Transfer Operations and Material Science

CFPE 3207 (Food Process Technology-II)

Lecture: 4 hrs/week,

No. of Credit: 4.00

Dairy Chemistry & Microbiology: Types of milk, roles of lipids, proteins, carbohydrates, minerals, vitamins and enzymes, importance of psychrophilic, mesophilic and thermophilic spoilage organisms in storage, pasteurization and sterilization.

Cream Separation and Homogenization: Principles of cream separation, equipment, effectiveness, cut-off diameter and energy requirement. Cream, and its types, pasteurization. Homogenizers: principle of operation, design calculation for laminar and turbulent regimes, technology of homogenized milk production.

Pasteurization and Sterilization: Process and equipment for milk pasteurization, direct and indirect sterilization; Ultra - High - Temperature (UHT) sterilization. Fouling of pasteurizers and sterilizers. Aseptic packaging. Technology and standards of commercial liquid milk products: toned, double toned products, reconstituted, recombined milk etc.

Concentration, Evaporation and drying: Process and equipment for evaporation and concentration of liquid milk, spray drying of liquid milk, energy consumption in spray drying, instantization methods, cyclone separation principle. Technology and standards of dried and condensed milk products. Cleaning and sanitization of dairy equipments and plant.

Dairy Products Manufacturing: Process Technology and standards of manufacturing of butter, cheese, Ice-cream, malted milk drinks, infant foods, fermented milk and other milk products (casein, whey proteins, lactose etc.). Indigenous dairy products manufacturing.

Poultry: Pre-slaughter care and consideration; Operations in preparation of dressed poultry, its storage and marketing, processing of poultry. Egg: structure, composition, nutritive value, egg products, dehydrated egg powder. Effect of processing on nutritive value; additives used in poultry products.

Fish: Effect of method of catching and handling on the quality of fish; handling fish from catching to transportation; post mortem changes, rigor mortis, autolytic changes, bacteriological changes, rancidity, physical changes; preservation of fish by different methods: chilling, freezing, modified atmosphere packaging, canning, curing, marinate; changes in fish proteins on storage; manufacture of fish protein concentrate, fish sauce, fermented fish:

packaging of fish; effect of processing on nutritive value.

Meat: Ante-mortem examination of meat animals, scientific techniques of stunning and slaughtering; carcass evaluation; muscle contraction, water holding capacity, post mortem changes, meat colour, meat tenderizer; processing of meat and meat products: freezing, cooking, drying, curing, smoking; composition of smoke, carcinogenic contents, additives used; manufacture of sausages, comminuted meat products: ham, bacon, meat analogues; effect of processing on nutritive value, spoilage of meat; packaging of meat and meat products.

CFPE 3208 (Food Process Technology-II Sessional)

Lecture: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Food Process Technology-II

CFPE 3209 (Molecular Cell Biology)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Biology and Bioprocess, Relevance to society. **Prokaryotes and eukaryotes. Classification of microorganisms and important cell types. Structures of the bacterial cell. Organization of plant and animal cells, organelles, structure, chemical composition, function.** Biomolecules: properties of water amino acids, proteins, carbohydrates, lipids and nucleic acids. Cellular processes: carbon and nitrogen cycle in nature, metabolic grid, glycolysis. TCA cycle and forms of energy in biology. Signal transduction, receptor concept, nature of ligand-receptor interactions. Information transfer in cells: Central dogma, DNA replication, RNA transcription, genetic code and translation. Genetics and inheritance: chromosomes, Mendel's laws, phenotype and genotype, genetic diseases in humans. Special topics: Genetic engineering, Cell culture and immune system

CFPE 3200 (Case Study in Chemical & Food Process Engineering)

Training: 2 hours/week

No. of Credit: 1.00

The students will be assigned to specific supervisor to conduct their case study; they will survey literature for selection of suitable topic; the students will submit a report at the end of the semester.

Courses of the B.Sc. Engineering 4th Year

4th Year Odd Semester

SL. No.	Course No.	Course Title	Conduct Hours/ Week	Credits
Theory Courses				
1.	CFPE 4129	Refrigeration and Air Conditioning	3.00	3.00
2.	CFPE 4107	Instrumental Methods and Process Control	3.00	3.00
3.	CFPE 4109	Process Equipment Design & Economics	3.00	3.00
4.	CFPE 4111	Food Packaging, Transportation and Storage	3.00	3.00
5.	CFPE 4113 (*)	Optional-I	3.00	3.00
Sessional Courses				
6.	CFPE 4108	Instrumental Methods and Process Control Sessional	1.50	0.75
7.	CFPE 4112	Food Packaging, Transportation and Storage Sessional	3.00	1.50
8.	CFPE 4100	Project and Thesis	3.00	1.50
9.	CFPE 4110	Seminar	2.00	1.00
		Total	24.50	19.75

4th Year Even Semester

Sl. No.	Course No.	Course Title	Conduct Hours/ Week	Credits
Theory Courses				
1.	CFPE 4201	Chemical Processes	3.00	3.00

2.	CFPE 4203	Food Quality and Safety	3.00	3.00
3.	CFPE 4209	Chemical Processes Design	3.00	3.00
4.	CFPE 4213 (*)	Optional-II	3.00	3.00
5.	CFPE 4215 (*)	Optional-III	3.00	3.00
Sessional Courses				
6.	CFPE 4204	Food Quality and Safety Sessional	1.50	0.75
7.	CFPE 4212	Design Lab	1.50	0.75
8.	CFPE 4200	Project and Thesis	6.00	3.00
9.	CFPE 4210	Seminar	2.00	1.00
		Total	26.00	20.50

Detail Syllabus of the B.Sc. Engineering 4th Year Odd Semester

CFPE 4129 (Refrigeration and Air Conditioning)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Refrigeration: Concept and application of refrigeration, different refrigeration methods, Refrigerants, Analysis of vapor-compression refrigeration system and its modifications, Absorption refrigeration, Air-cycle refrigeration, Low-temperature refrigeration, Multi-pressure systems of refrigeration. Refrigeration equipment: Defrost mechanism and automatic controls used in commercial refrigeration systems, Heat-flow problems in condensers and evaporators. Manufacture of water ice and dry ice.

Air Conditioning: Concept and classification of a/c and its use, Psychometric properties, comfort data, cooling and heating load calculation of various applications, Air distribution system and duct design, Air conditioning equipment, Air purification, Installation of units, Charging, Leak detection, wiring diagram and service, Trouble shooting.

CFPE 4107 (Instrumental Methods and Process Control)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Principle of measurement by using analytical instruments such as: Chromatographic techniques: General principles. Partition and adsorption chromatography, Paper, thin layer, gas liquid, ion exchange and affinity chromatography. Gel filtration, High Pressure Liquid Chromatography. Electrophoretic Techniques: General principles, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis. Spectroscopy: Beers and Lambert's Law. Extinction coefficient. General principles of colorimeters and spectrophotometers, AAS, Emission spectroscopy, IR spectroscopy. Fluorimetry, Spectrofluorimeters. Use of radioisotopes.

Acceptance sampling: operational characteristics, risks, attribute sampling plans, administration of attribute, sampling error; Physical, chemical and rheological properties.

Control System: Introduction, classification of control system, system modeling, transfer function, stability analysis, compensation, various control system of modern instruments; microcontroller, PLC, control system in chemical and food process industries.

CFPE 4108 (Instrumental Methods and Process Control Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Instrumental Methods and Process Control

CFPE 4109 (Process Equipment Design & Economics)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Mechanical design of process equipment: pressure vessels, tall columns, etc., process piping design; Materials and Fabrication Selection;

Design Strategy and Optimum Equipment Design: Economic Design criteria; Cost and Asset Accounting; Cost Estimation; Interest and Investment Costs; Taxes and Insurance; Depreciation; Profitability, Alternative Investments and Replacement; Illustrative Case Study in Process Equipment Design and Costing of Equipment in each of the following categories: Material Transfer, Handling and Treatment Equipment

Heat Transfer Equipment: Shell and tube heat exchangers (Kern and Bell-Delaware design methods), Plate heat exchangers, Evaporators

Mass Transfer Equipment: Absorption/ Stripping columns (packed/tray),

Multicomponent distillation column (Fenske-Underwood-Gilliland correlations)

Reactors: choice of reactors, non-isothermal reactors, reactor configuration, interstage heating/cooling, multi-tubular reactors, catalyst deactivation.

CFPE 4111 (Food Packaging, Transportation and Storage)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Introduction: Importance and Functions of Food Packaging, Packaging requirements for cereals, meat, poultry, fish, milk, vegetables, fruits, plantation crop based products and carbonated beverages Types of **Packaging**

Materials: Polymer Films - Physical, chemical and permeability properties, manufacturing methods, testing and identification, permeability modeling, migration of chemicals. Metal Containers: Strength requirement, seaming and coating properties, contamination from lacquers. Glass containers and closures.

Food Packages: Rigid and Flexible packages: paperboard, lamination and sealing techniques, machinery for forming packages. Special packing: gas, vacuum and aseptic packaging, Advances in Food Packaging: Smart packaging, Intelligent Packaging, Active Packaging and Antimicrobial packaging, Retortable pouches, biodegradable and edibles packaging materials and films.

Testing of Packaging Material: Destructive & Nondestructive test, Testing of rigid, semi rigid and flexible packaging material, Shelf life study etc. Corrosion and toxicity of packaging material.

Material Handling: Solids and granular materials handling - elevators, conveyors; Pumps - centrifugal and positive displacement; Liquid filling machines - open vent, closed vent and piston fillers.

Food Transportation: Modes, transportation damages, and their minimization.

Storage Principle and Practice: Storage losses and their estimation: Modified and control atmosphere storage: Bin and silo storage for cereals and pulses; Loss in cereal quality – insect and pest control.

CFPE 4112 (Food Packaging, Transportation and Storage Sessional)

Sessional: 3 hrs/week,

No. of Credit: 1.50

Sessional based on Food Packaging Transportation and Storage

CFPE 4100 (Project and Thesis)

Sessional: 3 hrs/week,

No. of Credit: 1.50

The students will start their project work effectively on the basis of progress of case study in previous semester. They will gather their research idea practically and will complete experimental set-up /fabrication, also do some trial runs.

CFPE 4110 (Seminar)

Sessional: 2 hrs/week,

No. of Credit: 1.00

Every student will present their research progress in front of an evaluation board at least thrice throughout the semester. They will gather new idea/suggestions from the audience and will revise their work accordingly.

Detail Syllabus of the B.Sc. Engineering 4th Year Even Semester

CFPE 4201 (Chemical Processes)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Introduction to fuels, Properties of fuels, Solid fuels and uses, liquid fuels and uses, Gaseous fuel and uses, Combustion and furnace calculations. **Chemical processes based on agricultural and silvicultural raw materials:** Sugar, starch, alcohol, cellulose, paper, glyceride, oils, soaps, detergents.

Petroleum refining Operations: Principles and details of Crude Distillation, Vacuum Distillation, coking, cracking, pyrolysis, hydrotreating, isomerization and alkylation.

Petrochemicals: Raw materials and principles involved in the production of olefins and aromatics. Acetylene, Butadiene and typical intermediates from olefins and aromatics such as ethylene glycol, ethyl benzene, phenol, cumene and DMT/PTA; dyes and pharmaceuticals, coal chemicals. **Inorganic heavy chemicals:** Processes for manufacture of acids, alkalis, salts and fertilizers. Typical products such as sulphuric, nitric, and phosphoric acids, soda ash, ammonia, superphosphates. Renewable resources, Biorefineries. Biopharmaceuticals. Fine chemicals and Biotransformations.

CFPE 4203 (Food Quality and Safety)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Quality and Assurance: Definition, scope, importance and difference, Total quality control and (TQC) Total quality management (TQM), Statistical quality control. Definition, importance, scope and difference between food quality and food safety.

Sensory Evaluation: Selection of panel of judges, Prerequisite for sensory analysis, application of consumer tests; control of factors affecting of sensory verdict, Instrumental measurements of sensory attribute of foods sensory characteristics of foods, types of tests, Texture profile analysis. Correlation between instrumental and Sensory analysis of food quality attributes.

Raw materials & Finished product quality: Quality parameters and evaluation procedures: appearance, color, texture, viscosity, consistency, flavour etc.

Food standards and laws: International – Concept of Codex Alimentarius, HACCP, GMP, GHP, USFDA, ISO 9000, ISO 22000, ISO 14000. Export Quality Control and Inspection act (1963), Environment Protection Act (1986), WTO & GATT, etc. GMP, GHP. National – Compulsory and voluntary trade and Company standards. Consumer Protection Act (1986), BIS/IS, Food Safety and standards – 2006, FPO, MPO, MMPO, Agmark. GMP, GHP.

Quality Certification & Accrediation: Introduction and procedure **Prevention of food adulteration Act:** Food Adulteration: definition, common adulterants in different foods, contamination, method of detection, Food additives and legislation; PFA specification for food products, Nutritional labeling

Risk and Hazard associated with Food: Food hazards, sources of hazard, classification, Food safety; prevention and control, Statistical quality control. HACCP, Quality costs.

CFPE 4204 (Food Quality and Safety Sessional)

Lecture: 1.5 hrs/week,

No. of Credit: 0.75

Sessional based on Food Quality and Safety

CFPE 4209 (Chemical Processes Design)

Lecture: 3 hrs/week,

No. of Credit: 3.00

Process Design and Development: General Design Considerations; The Hierarchy of Chemical Process Design; The Nature of Process Synthesis and Analysis;

Reactor networks in process flowsheets: Attainable region

Separation systems in process flowsheets: multicomponent distillation for ideal and non-ideal systems, distillation column sequences, heat integration in distillation columns.

Heat exchange networks synthesis and utilities: Energy targets Introduction to optimization approaches to optimal design, role of simulations in process design, Design under uncertainty and failure tolerance, Engineering around variations, Introduction to process integration.

CFPE 4212 (Design Lab)

Lecture: 1.5 hrs/week,

No. of Credit: 0.75

Steady-state simulation of flow sheets; Optimization and costing in flow sheets; Design and analysis of control systems; Simulations using commercial simulators (e.g. ASPEN, HYSYS), Computational Fluid Dynamics, Molecular modeling.

Process and mechanical design calculations for process equipment; Numerical studies in reactor design; Design and analysis of separation equipment.

CFPE 4200 (Project and Thesis)

Sessional: 6 hrs/week,

No. of Credit: 3.00

The students will take data using the experimental set-up that was completed in previous semester. They will also conduct performance study of the system and will make conclusion on their research project; the students will also submit a project report for evaluation at the end of the semester.

CFPE 4210 (Seminar)

Sessional: 2 hrs/week,

No. of Credit: 1.00

Every student will present their research progress in front of an evaluation board at least thrice throughout the semester. They will gather new idea/suggestions from the audience and will revise their work accordingly.

The students will present their project work in front of an examination board at the end of semester final examination.

Detail Syllabus of the Optional Courses for Undergraduate Studies

Optional-I

Lecture: 3 hrs/week,
3.00

No. of Credit:

CFPE 4113 (a) (Bakery and Confectionary Technology)

Current status, growth rate, and economic importance of Bakery and Confectionary Industry in India. Product types, nutritional and safety of products, pertinent standards & regulations.

Bakery Products: Ingredients & processes for breads, biscuits, cookies & crackers, cakes & pastries; doughnuts; rusks; other baked products. Equipments used, product quality characteristics, faults and corrective measures for above bakery products. Defining and assessing quality of ingredients & products.

Confectionary Products: Hard-boiled candies, toffees, fruit drops, chocolates and other confections:- ingredients, equipments & processes, product quality parameters, faults and corrective measures. Production & quality of chewing and bubble gums, cocoa products, breakfast cereals, macaroni products, sprouted grains.

CFPE 4113 (b) (Food Plant Hygiene and Sanitation)

General principle of food hygiene, Hygiene in rural and urban areas in relation to food preparation, personal hygiene and food handling habits. Place of sanitation in food plants.

Sanitary aspects of building and equipment: Plant layout and design, Comparative studies on sanitary fabrication of different types of processing equipments.

Safe and effective insect and pest control: Extraneous materials in foods, Principles of Insects and pests control. Physical and chemical control. Effective control of micro-organisms: microorganisms important in food sanitation, micro-organisms as indicator of sanitary quality. Physical and chemical methods.

Sanitary aspects of water supply: Source of water, quality of water, water supply and its uses in food industries. Purification and disinfection of water

preventing contamination of potable water supply.

Effective detergency and cleaning practices: Importance of cleaning technology, physical and chemical factors in cleaning, classification and formulation of detergents and sanitizers, cleaning practices.

Sanitary aspects of waste disposal: Establishing and maintaining sanitary practices in food plants, role of sanitation, general sanitary consideration and sanitary evaluation of food plants.

CFPE 4113 (c) (Environmental Engineering in Chemical & Food Processing)

Basic considerations: Standards for emission or discharge of environmental pollutants from chemical and food processing Industries as per the updated provision of Environment (Protection) Act, 1986. Elements of importance in the efficient management of chemical and food processing wastes.

Characterization and utilization of by-products from Polymer, Petrochemical, Fertilizer, Pulp and paper, Cereal Pulses, Oilseeds, Fruits and vegetables, Plantation products, Fermented foods, Milk, Fish, Meat, Egg and poultry processing industries.

Characterization of chemical and food industry effluents: Physical and chemical parameters, Oxygen demands and their interrelationships, Residues (solids), Fats, Oils and grease, Forms of Nitrogen, Sulphur and Phosphorus, Anions and cations, Surfactants, Colour, Odour, Taste, Toxicity. Unit concept of treatment of chemical and food industry effluent, Screening, Sedimentation Flootation as pre - and primary reactants.

Biological oxidations: Objects, Organisms, Reactions, Oxygen requirements, Aeration devices Systems: Lagoons, Activated sludge process, Oxidation ditches, Rotating biological contractors and their Variations and advanced modifications.

Advanced wastewater treatment systems: Physical separations, Micro-trainers, Filters, Ultra filtration and reverse osmosis. Physico-chemical separations: activated carbon adsorption, Ionexchange electro-dialysis and magnetic separation. Chemical oxidations and treatment Coagulation and flocculation. Disinfection. Handling disposal of sludge.

Optional II

Lecture: 3hrs/week,

No. of Credit: 3.00

CFPE 4213 (a) (Polymers, Petroleum & Petrochemical Processing)

Introduction, Prospect of polymer, petroleum and petrochemical industries in Bangladesh. Raw materials of polymers and petrochemicals.

Polymers: Classification of polymeric materials and their chemical structure; nomenclature for polymers; molecular weight and its measurement; polymerization mechanisms and methods; reactor types; manufacture and technological properties and testing standards of PE, PP, PVC, PVA, PTFE, nylons, polyesters and rubbers (butadiene, isoprene, styrene).

Petroleum: Origin, formation and composition of petroleum. Evaluation of crude oils. Refinery products and their uses. Analysis of petroleum products. Fractionation of petroleum. Production of lubricating oils and greases. Bitumen production. Reaction mechanism, kinetics and technological aspects of some thermal and catalytic processes; thermal cracking, coking, pyrolysis, catalytic cracking, hydrocracking, catalytic reforming, hydrogen treating, isomerisation, alkylation. Refinery flow sheeting, equipment, design, layout, safety and environmental aspects.

Petrochemicals: reaction mechanism, kinetics, manufacturing technologies and uses of ammonia, methanol, oxochemicals, acetylene, vinylchloride, synthetic detergents, olefins, dienes, waxes and aromatics.

CFPE 4213 (b) (Fertilizer, Pulp and Paper Technology)

The world fertilizer market. Fertilizer industries in Bangladesh Nitrogen fertilizers (ammonia, urea): raw materials, reaction kinetics, manufacturing processes, design considerations, status of production, comparative economics of different nitrogenous fertilizers. Phosphate fertilizers (SSP, TSP): raw materials, reaction kinetics, manufacturing processes, design considerations, comparative economics of different phosphate fertilizers. Manufacturing process of different potash fertilizers and their uses. Complex and compound fertilizers and their economics. Waste disposal methods. The world pulp and paper market. Pulp and paper industries in Bangladesh. Types of raw materials, composition and chemical properties

of wood. Preparation of raw material for pulping. Comparative assessment of the different pulping processes. Kraft process: chemistry, digesters, black liquor recover unit. Bleaching, beating and sizing. Paper making. Waste disposal methods.

Optional III

Lecture: 3hrs/week,

No. of Credit: 3.00

CFPE 4215 (a) (Glass, Ceramic & Cement Technology)

Structural characteristics of ceramic materials, Kinetics of high temperature reaction including sintering and vitrification. Melting crystallization and glass formations. Ceramic phase equilibrium diagrams. Non-equilibrium phases. Raw materials, manufacturing processes and properties of glass, porcelain, refractories and whitewares. Glazing and decorating of porcelain and stonewares. Firing methods and kilns for ceramic and whitewares. Furnaces for glass manufacture. Raw materials, manufacturing processes and properties of cement. Heat and mass balance around kiln.

CFPE 4215 (b) (Pyrolysis Oil Production Technology)

Introduction: Basic concepts of pyrolysis, Classification, Historical development, Application of pyrolysis technology in waste to oil energy conversion process.

Reaction Kinetics: Definition, reaction order, rate and rate constant.

Characterization of wastes: Classification and characterization of wastes available in the modern society: physical, chemical and thermal gravimetric analysis. Waste separation and feed preparation techniques.

Pyrolysis reactors: Classification and modern development of pyrolysis reactors with their respective applications. Details study of the fixed bed, fluidized bed and co-pyrolysis reactors.

Overview of current pyrolysis plants for production of pyro-crude oil from different wastes. Upgrading of the pyro-crude oil using catalytic and non-catalytic processes.

Characterization of pyrolysis oil: Physical and chemical characterization techniques using modern tools: Elemental analyzer, FTIR analyzer, GCMS analyzer and NMR analysis techniques. Comparison of the pyrolysis oils with

conventional petroleum fuels to be used in IC engines.

CFPE 4215 (c) (Introduction to Transport Phenomena)

Introduction: Vectors/Tensors, Viscosity, Shell balance: Falling film, Circular tube; Equations of Change for isothermal systems: Continuity, Motion, Energy, Substantial derivatives; Unidirectional flows: Pipe flow, Variable viscosity falling film, Couette viscometer, Rotating Sphere; Unsteady flows: Startup Plate flow, Parallel plates, Oscillating plate; Thermal conductivity and mechanism of energy transport; Shell energy balances and temperature distributions in solids and laminar flow; The equations of change for nonisothermal systems; Diffusivity and the mechanisms of mass transport; Concentration distributions in solids and laminar flow; Equations of change for multicomponent systems; Introduction to the concept of heat and mass transfer coefficients.