

**Department of Food Engineering
From Batch 2021**

CURRICULUM

First Year (Fall Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-104 Introduction to Food Engineering	FE Fall Semester	2+0
<p>COURSE TOPICS</p> <p>Historical Background of Food Engineering: Food engineering and its scope, Importance of chemistry and biological science in food engineering.</p> <p>Food Processing: Baked and snack foods, honey, syrups, confectionery, beverages, milk and fish.</p> <p>Thermal Techniques in Food Processing: Heat processing of food, Freezing and cold storage, Microwave heating.</p> <p>Introduction to mass and energy balance: Mass and energy balance and its application in food processing.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
PH-127 Applied Physics for Engineers	FE Fall Semester	2+1
<p>COURSE TOPICS</p> <p>Introduction and properties of matter and fluids Introduction of Engineering Physics, Elasticity and modulus of elasticity, Bending of beams, Cantilever, Steady and turbulent flow, Bernoulli's theorem and Viscosity, Surface tension, Surface energy and Angle of contact.</p> <p>Heat and thermodynamics Heat, temperature and theories of heat, Adiabatic and isothermal processes and The four laws of thermodynamics. Thermodynamic functions, Efficiency of heat engines, Carnot's cycle, Entropy. Reversible process and cycles, Thermodynamic equilibrium, Introduction to heat transfer mechanisms.</p> <p>Waves and optics Waves and oscillations, Simple harmonic motion, Types of wave motion. Optics of light, Interference, Diffraction, Polarization Double refraction, Dispersion, Types and uses of deviation lasers.</p> <p>Electricity and magnetism Electric charges, Electric field, Electric potential, Coulomb's law, Gauss's law, Capacitors and dielectrics, Magnetic field, Magnetic force on current, Ampere's law Faraday's law, and Lenz's law. Electric current, Ohm's law, Magnetic properties of matter</p> <p>Sound waves Speed of sound, Different types of sound waves.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
CY-110 Applied Chemistry for Engineers	FE Fall Semester	2+1
COURSE TOPICS Electrochemistry: Laws of electrolysis, E.M.F series, corrosion (Theories, inhibition and protection). Water and sewage: impurities, hardness, water softening, purification of water for portable and industrial purposes, introduction to environmental pollution, sewage treatment. Fuels: Types of fuels, classification, calorific value. Metals and Alloys: Properties and general composition of metals and alloys such as Iron, Copper, Aluminum, Chromium and Zinc used in engineering field. Engineering Materials: Inorganic engineering materials: cement, glass; organic engineering materials: polymers, rubbers, plastics and paints; semiconductors and dielectric materials.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-104 Functional English	FE Fall Semester	3+0
COURSE TOPICS Study Skill ; advanced reading skills using variety genre and texts; listening & speaking skill; oral communication skills development; precise writing; controlled & guided writing; essay writing; writing book & informal reports; informal & formal letters and memos; creating advertisements; applied grammar; sentence correction sentence completion; transformation of sentences; question tages; homonyms/homophones, sentence making, punctuation; extracts; conversations etc.; use of idioms.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
BM-108 Computer Aided Engineering Graphics	FE Fall Semester	1+2
COURSE TOPICS <u>Introduction to Computer Aided Drafting:</u> Introduction to the Engineering design Process, Technical Graphics basics, Orthographic projection and Isometric drawings and basic concepts of Conventional engineering drawings. Opening a new drawing, paper setting, coordinate systems: User's coordinate system (UCS), Cartesian coordinates and Polar coordinates; saving a drawing. <u>Creating Elementary Objects:</u> Apply the Commands: Grid, Ortho, Escape, Erase, Trim, Undo, Draw Lines, Circles, Ellipse, Rectangle And Arcs. <u>Basic Object Editing:</u> Apply the following commands: Move, offset, rotate, fillet, chamfer, array and mirror. <u>Dimensioning:</u> Show the following dimensioning: Linear, aligned, radial and changing dimensional setting. <u>Solid Modeling:</u> Apply the following commands to create 3-D models: Region, extrude, revolve, slice and show plan; elevation and end view of a 3-D model. <u>Controlling Drawings:</u> Apply the following commands for a given drawing: Hatching, coloring and rendering.		

Text:

Apply the following commands on the given drawing: Creating text, style of text and changing text properties.

Plotting Drawings:

Apply the following commands: Plotting, print preview and printing.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
MT-114 Calculus	FE Fall Semester	3+0
COURSE TOPICS		
<u>Set and Functions:</u>		
Define rational, irrational and real numbers; rounding off a numerical value to specified number of decimal places or significant figures; solving quadratic and rational inequalities in involving modulus with graphical representation. Definition of set, set operations, venn diagrams, DeMorgan's laws, Cartesian product; relations; function and their types; absolute value; greatest integer and combining functions. Graph of some well-known functions, limit of functions, continuous and discontinuous functions with graphical representation.		
<u>Propositional Logic:</u>		
Definition of proposition; statement and argument; logical operators; simple and compound proposition; various types of connectives; truth table; Tautology; contradiction; contingency & logic equivalence.		
<u>Boolean Algebra:</u>		
Definition; boolean function; duality; some basic theorems & their proofs. Two values boolean algebra, truth functions, canonical sum of product form, digital logic gates & switching circuit designs.		
<u>Complex Number:</u>		
Argand diagram; DE Moivres formula root of polynomial equations; curve and regions in the complex plane; standard functions and their inverses (exponential, circular and Hyperbolic functions).		
<u>Differential Calculus:</u>		
Differential and successive differentiation and its application: Leibnitz theorem. Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange from power series. Taylor and Maclaurin series; L Hopitals rule; extreme values of a function of one variable using first and second derivative test; asymptotes of a function curvature and radous of curvature of a curve; partial differentiation exact differential and its application in computing errors; extreme values of a function of two variables with a without constrains. Solution of non-linear equation using Newton Raphson method.		
<u>Integral Calculus:</u>		
Indefinite integrals and their computational techniques; reduction formulae, definite integrals and their convergence. Beta and Gamma functions and their identities, applications of integration (centre of pressure and depth of centre of pressure).		
<u>Solid Geometry:</u>		
Coordinate system in three dimensions; direction cosines and ratios equation of a straight line, plane and sphere; curve tracing of a function of two and three variables; surfaces of revolutions; transformations (Cartesian to polar & cylindrical).		

First Year (Spring Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-105 Food Engineering Principles	FE Spring Semester	2+0
<p>COURSE TOPICS</p> <p>Introduction to fundamental of food engineering: Physical attributes, Size and size distribution, Shape, volume, density, porosity.</p> <p>Rheological properties: Flow of materials; Newton's law of viscosity, Viscous fluids, Plastic fluids, Measurement of viscosity.</p> <p>Deformation of materials; Viscoelastic behavior, Stress relaxation test, Creep test, Dynamic oscillatory test.</p> <p>Textural properties: Texture profile analysis, Compression, snapping-bending, Cutting shear, puncture, penetration.</p> <p>Water activity and sorption properties: Prediction and measurement of water activity, Effect of temperature and pressure on water, Activity, preparation of sorption isotherms.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
CY-108 Analytical Chemistry	FE Spring Semester	3+1
<p>COURSE TOPICS</p> <p><u>Introduction to Analytical Chemistry:</u> Review of some basic concepts, statistical analysis; mean, median, mode, standard deviation, relative standard deviation, variance.</p> <p><u>Gravimetric and Volumetric Analysis:</u> Volumetric analysis; neutralization titration, complexation titration, oxidation-reduction titration and precipitation titration; gravimetric analysis; precipitation method, thermo gravimetric method and volatisation method.</p> <p><u>Aqueous Solution:</u> Standard solution, primary and secondary standards, concentration of solutions, chemical equilibrium calculation.</p> <p><u>Potentiometric Techniques:</u> Potential difference and standard electrode potential, potentiometric titrations and use of potentiometry for qualitative analysis, pH meter (pH, buffer solutions, pH of polyfunctional acids).</p> <p><u>Chromatography:</u> Gas chromatography, high-performance liquid chromatography, ionexchange chromatography, paper chromatography, thin layer chromatography, electrophoresis.</p> <p><u>Spectroscopic Methods:</u> Molecular and atomic spectroscopy.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
CS-103 Programming Languages	FE Spring Semester	2+2
<p>COURSE TOPICS</p> <p><u>The Turbo C Programming Environment:</u> Setting up the integrated development environment; file used in C program development; use of integrated development environment; the basic structure of C program; explaining the printf() function.</p> <p><u>C Building Blocks:</u> Variables; input/output; operators; comments.</p> <p><u>Loops:</u> The for loop; the while loop; the do while loop.</p> <p><u>Decisions:</u> The if statement, the if-else statement; the else-if construct; the switch statement; the conditional operator. Functions: Simple functions; functions that return a value, using arguments to pass data to a function; using more than one functions; external variables; prototype versus classical K and R; preprocessor directives.</p> <p><u>Arrays and Strings:</u> Arrays; referring to individual elements of the array; string; string functions; multidimensional arrays.</p> <p><u>Pointers:</u> Pointer overview; returning data from functions; pointers and arrays; pointers and strings; double indirection; pointers to pointers. Structures, unions and ROM BIOS.</p> <p><u>Turbo C Graphics Functions:</u> Text-mode functions graphics - mode functions. Text with graphics.</p> <p><u>Files:</u> Types of disk I/O, standard, input/output binary mode and text mode; record, input/output; random access; error conditions; system level input/output; redirection.</p> <p><u>Advanced Variables:</u> Storage classes, enumerated data type, renaming data type with typedef; identifiers and naming classes; type conversion and casting; labels and goto statement.</p> <p><u>c++ and Object Oriented Programming:</u> Object oriented programming, some useful c++ features, classes and objects; constructors and memory allocations; inheritance; function overloading; operator overloading.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
EL-232 Electronics	FE Spring Semester	3+1
<p>COURSE TOPICS:</p> <p><u>Conduction in Solids</u> Introduction, Mechanics of conduction, Mobility, Bohr's model for the elements, Energy level diagrams for solids, Conductors, Intrinsic and extrinsic semiconductors, Electron-hole pairs in an intrinsic semiconductor, Distribution of electron and hole in conduction and valence bands, Recombination and lifetime.</p>		

Semiconductors and Diodes

Donor and acceptor impurities, Zero biased, Forward biased and reverse biased junction diodes, Junction diode current equation, Depletion barrier width and junction capacitance, Diffusion capacitance, Zero and Avalanche break down, Hall effect, Fabrication of pn junction, Diodes.

Electron Emission Devices

Types of electron emissions, Thermionic diode, Volt ampere characteristics, Child Langmuir power Law, Gas filled diode, Thermionic triode, Parameters and characteristics, Tetrode, Pentode, and beam power tubes, Parameters and characteristics.

Simple Diode Circuits and Applications

Mathematical and graphical analysis of diode circuits, The ideal and non ideal diodes, Piecewise linear models, Analysis of piecewise linear models of vacuum tube and junction diodes, The half wave rectifier, The inductance filter, The inductance capacitance filter circuits, Zener and gas diode, Voltage regulator circuits, Clamping and DC restorer circuits, Voltage doubler circuits, Clipping and limiting circuits.

Bipolar and Field Effect Transistors

Transistor biasing and thermal stabilization, The operating point, Bias stability, Collector to base bias, Fixed bias, Emitter feedback bias, Stabilization for the self biased circuits, Field effect transistors, Basic principles and theory, Types, FET characteristics, Different configurations- common gate, Common source and common drain, The FET, small signal model, Parameters, Biasing of the FET.

Amplifier Circuits

Introduction "h" parameters, Hybrid model for transistor, Elementary treatment, Low frequency transistor amplifier circuits, Stage cascaded LF.

TEXTBOOK

- Understanding Basic Electronics, Arri, 2nd edition, 2010

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-105 Pakistan Studies	FE Spring Semester	2+0
COURSE TOPICS		
<u>Historical and Ideological Perspective of Pakistan Movement:</u> Two nation theory; definition; significance; creation of Pakistan; factors leading to the creation of Pakistan; Quaid-e-Azam and the demand of Pakistan.		
<u>Land of Pakistan:</u> Geo-physical conditions; geo-political and strategic importance of Pakistan; natural resources- mineral; water and power.		
<u>Constitutional Process:</u> Early efforts to make a constitution - problems and issues; constitution of 1956 and its abrogation; constitution of 1962 and its abrogation; constitutional and political crisis of 1971; constitution of 1973; recent constitutional developments.		
<u>Contemporary Issues in Pakistan:</u> A brief survey of Pakistan economy; agricultural and industrial development in Pakistan; internal and external trade; economic planning and prospects; social issues; literacy & education in Pakistan; state of science & technology with special reference to IT education; Pakistan society and culture; environmental issues; hazards of atmospheric pollution; other forms of environmental degradation & their causes & solution; Pakistan's role in preservation of nature. Through international conventions/efforts.		

Foreign Policy:

Relations of Pakistan with neighbors; super powers; Muslim world.

Human Rights:

Conceptual foundations of human rights; what are human rights? Definition; significance and importance; comparative analysis of Islamic and western perspectives of human rights; UN system for protection of human rights; an overview; UN charter; international bill of human rights; implementation mechanism; other important international treaties and conventions; the convention on the elimination of all forms of discrimination against woman; international convention on the right; of child (CRC); convention against torture (CAT); refugee convention; Pakistan's response to human rights; at national and international level; constitutional provisions; Pakistan's obligations to international treaties and documents; minority rights in Pakistan; Pakistan's stand on violation of human rights in the international perspective.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-127 Pakistan Studies (For Foreigners)	FE Spring Semester	2+0
<p>COURSE TOPICS</p> <p><u>Land of Pakistan:</u> Land & People, Strategic importance, Important beautiful sights, Natural resources.</p> <p><u>A brief Historical background:</u> A brief Historical survey of Muslim community in the sub-continent, British rule & its impacts, Indian re-action, Two nation theory – Origin & development, Factors leading towards the demand of a separate Muslim state, Creation of Pakistan</p> <p><u>Government & Politics in Pakistan:</u> Constitution of Pakistan – A brief outline, Governmental structure – Federal & Provincial, Local Government Institutions, Political History – A brief account, Pakistan & the Muslim World, Relations with the Muslim countries.</p> <p><u>Language and Culture:</u> Origins of Urdu Language, Influence of Arabic & Persian on Urdu Language & Literature, A short history of Urdu literature.</p>		

Second Year (Fall Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-201 Thermodynamics	SE Fall semester	3+1
<p>COURSE TOPICS:</p> <p><u>Thermodynamics:</u> Thermodynamics and energy; dimensions and units; systems and control volume; properties.</p> <p><u>Energy and Energy Transfer:</u> Forms of energy; energy transfer by heat and work; mechanical work; first law of thermodynamics. Pure substances; phases of pure substance; property diagrams and tables; ideal gas equations; compressibility factor. Mass and energy analysis for closed systems and control volumes; examples.</p> <p><u>Second Law of Thermodynamics & Entropy:</u> Second law concepts; reversible and irreversible process; Carnot cycle; entropy; isentropic processes; increase of entropy principle. Power and Refrigeration cycles; Essential equipment.</p> <p><u>Thermodynamics Properties for Mixture:</u> Maxwell relations; Clapeyron equation; Joule Thomson Coefficient; Gibbs free energy and fugacity for pure substance; criteria for phase equilibria in multi-component system; vapor-liquid equilibrium.</p> <p><u>Chemical & Phase Equilibria:</u> Chemical equilibrium in single phase system; chemical reactions; combined chemical and phase equilibrium. pH as criteria for ionization of biochemicals;</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
BM-201 Engineering Mechanics	SE Fall Semester	3+1
<p>COURSE TOPICS</p> <p><u>Introduction:</u> General principles; units of measurement</p> <p><u>Force Vectors:</u> Addition of vectors; Cartesian vectors; free vector; position vectors; force directed along a line.</p> <p><u>Equilibrium of a Particle:</u> Conditions for the equilibrium; free body diagram; 3D force systems; force system resultants; moment of force; Virognon's theorem; cross product; moment of a couple; equivalent systems.</p> <p><u>Equilibrium of a Rigid Body:</u> Equilibrium in 2D and 3D; constrains for a rigid body; redundant and improper constraints.</p> <p><u>Friction:</u> Types of friction; angle of repose; application of friction.</p> <p><u>Kinematics of a Particle:</u> Rectilinear motion; curvilinear motion; motion of projectile; absolute dependent motion of two particles.</p> <p><u>Kinetics of a Particle:</u> Equation of motion for a system of particle; equation of motion in rectangular, cylindrical, normal and tangential coordinates; principles of work and energy for a system of particles; linear</p>		

momentum; conservation of momentum; impact; angular momentum; kinematics of a rigid body; translation; rotation.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-207 Food Chemistry	SE Fall semester	3+0
COURSE TOPICS		
<u>Chemical Composition of Foods:</u> Carbohydrates, proteins, lipids, water, vitamins, minerals, enzymes, phenolic compounds and pigments.		
<u>Food Additives:</u> Preservatives, colorants, antioxidants, sweeteners, emulsifiers.		
<u>Toxicological concepts:</u> Contaminants and evaluation of metals, radionucleides, pesticides, hormones, antibiotics mycotoxins, polycyclic aromatic hydrocarbons and toxic compounds naturally found in foods.		
<u>Nutritional value of food:</u> Calorific value and pH of food.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-209 Fluid Mechanics-I	SE Fall semester	3+1
COURSE TOPICS		
<u>Fluid Properties:</u> Definition of fluid, Classification of fluids, Concept of continuum, Viscosity, Vapor pressure, Surface tension, Variation of fluid properties with temperature.		
<u>Fluid Statics:</u> Concept of pressure and basic equation for compressible and incompressible. Pressure measurements and devices, Hydrostatic forces on plane and curved surfaces. Buoyancy and stability, Pressure variation in fluid with rigid body motion.		
<u>Fluid Kinematics:</u> Flow characterization, Description of velocity and acceleration field (Streamlines, streak-lines and path-lines), Control volume and control mass, Deriving Reynold transport theorem (RTT).		
<u>Fluid Dynamics:</u> Application of Newton's 2 nd law in fluids. Total, stagnation and dynamic pressures. Deriving Bernoulli equation and its applications.		
<u>Integral Analysis of Fluid Flow:</u> Deriving continuity, linear momentum and moment of momentum equations using RTT. Solving problems related to continuity, linear and angular momentum.		
<u>Flow in Pipes:</u> Characteristics of pipe flow laminar and turbulent, calculating friction factor and wall shear stresses, and Solving pipe flow network problems.		
<u>Dimensional Analysis:</u> Dimensional analysis, similitude and modeling. Buckingham Pi theorem and determination of Pi group terms.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
MT-223 Differential Equation and Fourier Series	SE Fall semester	3+0
<p>COURSE TOPICS:</p> <p><u>1st Order Differential Equations</u> Basic concept; Formation of differential equations and solution of differential equations by direct integration and by separating the variables; Homogeneous equations and equations reducible to homogeneous form; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories; Application in relevant Engineering.</p> <p><u>2nd and Higher Orders Equations</u> Special types of 2nd order differential equations with constant coefficients and their solutions; The operator D; Inverse operator 1/D; Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.</p> <p><u>Partial Differential Equation</u> Basic concepts and formation of partial differential equations; Linear homogeneous partial differential equations and relations to ordinary differential equations; Solution of first order linear and special types of second and higher order differential equations; D'Alembert's solution of the wave equation and two dimensional wave equations; Lagrange's solution: Various standard forms.</p> <p><u>Laplace Integral & Transformation</u> Definition, Laplace transforms of some elementary functions, first translation or shifting theorem, second translation or shifting theorem, change of scale property, Laplace transform of the nth order derivative, initial and final value theorem Laplace transform of integrals. Laplace transform of functions in F(t) and F(t)/t, Laplace transform of periodic function, evaluation of integrals, definition of inverse Laplace transform and inverse transforms, convolution theorem, solutions of ordinary differential using Laplace transform.</p> <p><u>Fourier series</u> Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients; Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series, "DFT and FFT, Fourier Spectrum".</p>		

Second Year (Spring Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-208 Food Biochemistry	SE Spring Semester	2+1
<p>COURSE TOPICS</p> <p>Basic Concept of Biochemistry: Overview of cellular structure and process, Lipid and membranes. Acid, base and buffers.</p> <p>Carbohydrates and its Metabolism: Structure. Classification, Dietary fibre, Digestion of carbohydrates, Oxidation of glucose (Glycolysis), Citric acid cycle and production of energy.</p> <p>Lipids: Structure. Classification, Fatty acids and triacylglycerides, Digestion of lipid, Fatty acid oxidation.</p> <p>Amino Acids and Proteins:</p>		

Classification of amino-acids, Protein structure and functions, Protein digestion and amino acid absorption.

Micronutrients:

Vitamins, Minerals elements.

Enzymes:

Structure, Classification, Mechanism of enzymes, application.

Biochemistry of Food:

Biochemistry of fruits, vegetables, meat and poultry.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-210 Fluid Mechanics-II	SE Spring Semester	2+1
COURSE TOPICS		
Differential Analysis of Fluid Flow:		
Deriving continuity equation by applying principle of conservation of mass, calculating velocity and acceleration field using material derivative. Deriving Navier – Stokes equation, solving Navier – Stokes equation for simple geometries.		
Potential Flow Theory:		
Concept of Vorticity, Circulation, Inviscid and Irrotational flow fields, Basic velocity potential functions and their superposition, Prediction of Lift and Drag using potential flow theory.		
Flow Over Immersed Bodies:		
Boundary layer theory and its thicknesses, Concept of local and average drag coefficient, Calculating drag and lift forces due to pressure and velocity field.		
Turbomachinery		
Classification of fluid Machines, Fans, Pumps, turbines and other flow devices Deriving Euler’s equation of Turbo-machine, Solving turbo-machine problems using velocity triangle. Turbo machine performance characteristic curves, Series and Parallel combination of pumps, affinity laws.		
Introduction to Compressible Flows:		
Mach number and speed of sound, Isentropic flow of an ideal gas, Convergent and divergent nozzle.		
Introduction to Open Channel Flow:		
Steady, 1 dimensional open channel flow analysis, Froude Number, uniform flow channels and critical depth.		
Introduction to Computational Fluid Dynamics:		
Finite difference formulations, Concept of discretization, Solving simple fluid flow problems using available CFD code.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
MM-205 Mechanics of Materials	SE Spring Semester	3+1
COURSE TOPICS		
Review mechanics of materials. Deformation; strain; elastic stress-strain behavior of materials; Introduction to stress-strain diagram, working stresses, unit design, Introduction to elastic and nonlinear continua. Poisson’s ratio; Determination of forces in frames; Simple bending theory; general case of bending; Shear force and bending moment diagrams; Relationship between		

loading, shear force and bending moment. Stress; Skew (antisymmetric) bending Direct, shear, hydrostatic and complementary shear stresses; Bar and strut or column; Theory of buckling instability, Thin ring, Elementary thermal stress and strain; General stress-method. Theory of elasticity, Analytical solution of elasticity problems brittle fracture strain energy in tension and compression.

Analysis of bi-axial stresses, principal planes, principal stress-strain, stresses in thin walled pressure vessels. Mohr's circles of bi-axial stress. Torsion of circular shafts, coiled helical spring, strain energy in shear and torsion of thin walled tubes, torsion of non-circular sections. Shear centre and shear flow for open sections, General case of plane stresses, principal stress in shear stresses due to combined bending and torsion plane strain. Composite materials, Volume dilatation, Theories of Yielding, Thin Plates and Shells Stress Concentration.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
MT-332 Advanced Calculus & Linear Algebra	SE Spring Semester	3+0
<p>COURSE TOPICS</p> <p><u>Linear Algebra:</u> Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal tri-diagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix, basic concept of tensors, eigen value and eigen vectors of a matrix, Diagonalization, Cayley-Hamilton theorem. Applications of linear algebra in Engineering.</p> <p><u>Euclidean Spaces and Transformation:</u> Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwarz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition or transformations.</p> <p><u>Advance calculus:</u> Define a stationary point of a function of several variables, define local maximum and saddle point for a function of two variables the stationary points of a several variables, obtain higher partial derivatives of simple functions of two or more variables, iterated integrals, double and triple integrations with applications (area, centroid, moment of inertia, surface area, and volume, use multiple integrals in solutions of engineering problems.</p> <p><u>Vector Calculus:</u> Vector differential operator, directional derivative, gradient, divergence, curl of a vector field, and Laplacian operators with applications. (Solenoid, conservative, etc). Vector Integrations; Evaluate line integrals along simple paths, apply line integrals to calculate work done, apply Green's theorem in the plane to simple examples, evaluate surface integrals over simple surface, use the Jacobean to transform a problem a new coordinate system, apply Gauss' divergence theorem to simple problems, apply Stokes theorem to simple examples.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-205 Islamic Studies	SE Fall Semester	2+0
<p>COURSE TOPICS</p> <p><u>Thematic Study of HoyQuran:</u> Basic Islamic believes, Topics, Tauheed, AlAmbiya-22, Al-Baqarah-163-164, Prophet hood, A-Imran-79, Al-Hashr-7, Al- Madah-3, Here-After, Al-Hajj-5, Al-Baqarah-48, Two Hadith, Basic Islamic Practices, Al-Mu'minin-I-II, Amre-Bil-MA' Roof WA-Nahi Anil Munkar, The concept</p>		

of Good & Evil, Importance & necessity of DA'Wat-e-Deen Al-Imran-110, Method of DA'Wat-e-Deen, An-Nehl-125, Al-Imran-04, Two Hadith, Unity of the Ummah, Al-Imran-103, Al-Hujurat-10, Al-Imran-64, Al-An'am-08, Kasb-e-Halal, Taha-81, Al-A'raf-32-33, Al-Baqarah-188, Two Hadith, Huquq-ul-Ibad, Right to Property, Al-Maidah-32, Right to Property, An-Nisa-29, Right of Respect & Dignity, Al-Hujurat-11-12, Freedom of Expression, Al-Baqarah-256, Right of Equality, Al-Hujurat-13, Economic Security, Al-Ma'arij 24-25, Employment Opportunity on Merit, An-Nisa-58, Excession Right to Justice, An-Nisa-135, Women Rights, An-Nehl-97, Al-Ahzab-35, An-Nisa-07, Relations With Non-Muslims, Al-Mumtahanah-8-9, Al-Anfa-6, last sermon of Hajj at Arafat on 10th Zil-Hajj, Translation & the important points of the sermon.

Serat Life of the Holy Prophet:

Birth, life at Makkah, declaration of Prophet hood, preaching & its difficulties, migration to Madina, brotherhood (Mawakhat) & Madina charter, the Hoiy war of the prophet (Ghazwat-e-Nabawi), Hujjatu-Wida.

Islamic Civilization:

Impacts of Islamic civilization on the sub-continent, the civilization of sub-content before Islam, the political, social & moral impacts of Islamic civilization on sub-continent, academic, intellectual, social & cultural impacts of Islam on the world.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-209 Ethical Behavior (Alternate course for Non Muslim Students)	SE Fall Semester	2+0
<u>COURSE TOPICS</u>		
<u>Introduction to Ethics:</u>		
Definition of Ethics, Definition between normative and positive science, Problem of freewill, Method of Ethics, Uses of Ethics.		
<u>Ethical Theories:</u>		
History of Ethics: Greek Ethics, Medieval, Modern Ethics, Basic concept of right and wrong: good and evil, Utilitarianism, hedonism, self-realization: egoism, intuitionism, rationalism, Kant's moral philosophy.		
<u>Ethics & Religion:</u>		
The relation of Ethics to religion Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, Islam.		
<u>Ethics, Society, and moral theory:</u>		
Ethical foundation of Rights and Duties, Applied Ethics, Society as the background of moral life, Universalism and Altruism, Theories of punishment.		

Third Year (Fall Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-301 Unit Operations in Food Engineering-I	TE Fall Semester	3+1
COURSE TOPICS <u>Preliminary preparative operation:</u> Cleaning, sorting, grading methods; Size reduction: Particle size distribution, classification, screening and sieving, mechanism of size reduction, machinery for crushing and grinding, disintegration of fibrous materials, energy requirements for communication of solids. <u>Pneumatic and Hydraulic Conveying:</u> Screw, vibrating, belt conveyors and elevators; Fluidization, mixing and agitation, Flow pattern and baffles, rate of mixing and power consumption, Centrifugation theory and applications. <u>Agglomeration Phenomena and its application:</u> Granulation, pelletization, tabling and storage. Filtration: Mechanism of filtration. Filter media. Flow through filter cake and/or cloth. Cake resistance and relation between thickness of cake and volume of filtrate.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-306 Instrumentation and Measurement For Food Engineers	TE Fall Semester	3+1
COURSE TOPICS Principles of Colour Measurement for Food, Colour Measurement of Foods by Colour Reflectance, Food Compositional Analysis Using Near Infra-red Absorption Technology Infra-red Remote Thermometry, In-line and Off-line FTIR Measurements, Microwave Measurements of Product Variables, Pressure and Temperature Measurement in Food Process Control, Level and Flow Measurement in Food Process, Ultrasound Propagation in Foods and Ambient Gases: Principles and Applications; Ultrasonic sensors for Food Industry, Rheological Measurements of Foods, Conductance/Impedance Techniques for Microbial, Chemosensors, Biosensors, Immunosensors, Electronic Noses and Tongues.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-309 Machine Design for Food Engineers	TE Fall Semester	3+0
COURSE TOPICS <u>Introduction to Food Machine Design:</u> Food Machinery designs, Design Tools and Resources, The Design Engineer's Professional Responsibilities, Safety and Product Liability <u>Machine Dynamics:</u> Kinematics of Motion, kinetics of Motion, Simple Crank and Cam Mechanisms, Linkages, Types of Links, Structure, Kinematic Pair, Degree of freedoms, Mechanism, Cams, Kutzbach and Grubler's criteria for planar mechanisms. <u>Types of Mechanisms:</u> Slider Crank Mechanisms and its Inversions, Kinematic Analysis of Cams, Single Slider Crank Mechanism and its Inversions, Double Slider Crank Mechanism and its Inversions, Four Bar Mechanisms and its Inversions.		

Failure Prevention:

Failures resulting from Static Loading:

Static Strength, Failure Theories for Ductile Materials and Brittle Materials. Maximum-Shear-Stress Theory for Ductile Materials, Distortion-Energy Theory for Ductile Materials, Coulomb-Mohr Theory for Ductile Materials, Failure of Ductile Materials Summary, Maximum-Normal-Stress Theory for Brittle Materials

Failures resulting from Variable Loading

Introduction to Fatigue loadings, Approach to Fatigue Failure in Analysis and Design. Fatigue-Life Methods, The Stress-Life Method The Linear-Elastic Fracture Mechanics Method, The Endurance Limit, Fatigue Strength, Endurance Limit Modifying Factors, Stress Concentration and Notch Sensitivity, Characterizing Fluctuating Stresses, Fatigue Failure Criteria for Fluctuating Stress.

Design of Simple Machine Elements of Food Machinery:

Design of Mechanical Springs

Pipe and Pipe joints:

Flexible Mechanical Elements: Belts, Flat and Round Belt drives, V Belts, Timing Belts, Design of a Belt Conveyor

COURSE CODE/TITLE MT-330 Applied Probability & Statistics	SEMESTER/TERMS OFFERED TE Fall Semester	CREDITS 2+1
<p>COURSE TOPICS</p> <p><u>Statistics</u> Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Sartorial & Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types.</p> <p><u>Measure of Central Tendency and Dispersion</u> Statistics Averages, Median Mode, Quartiles, Range, Moments, Skewness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.</p> <p><u>Curve Fitting</u> Introduction, fitting of a first and second degree curve, fitting of exponential and logarithmic curves related problems, Principle of least squares, Second order Statistics & Time series not in bit detail.</p> <p><u>Simple Regression & Correlation</u> Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems.</p> <p><u>Sampling and Sampling Distributions</u> Introduction, Population, Parameter & Statistics, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems.</p> <p><u>Statistical Inference and Testing of Hypothesis</u> Introduction, Estimation, Types of Estimates, Confidence interval, Tests of Hypothesis, Chi-Square distribution/test, one tails & two tails tests. Application in related problems.</p> <p><u>Probability</u> Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability,</p>		

Conditional probability, Baye's rule. Related problems in practical significance.

Random Variables

Introduction, Discrete & Continuous random variables, Random Sequences and transformations, Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markoverandom walks chain/Related problems.

Probability Distributions

Introduction, Discrete probability distributions, Binomial, Poisson, Hyper geometric & Negative binomial distributions. Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-304 Business Communication and Ethics	TE Fall Semester	3+0
<p>COURSE TOPICS</p> <ul style="list-style-type: none"> • Communication Skills (oral): <ul style="list-style-type: none"> • Definitions and Conditions, • Modes:verbal, non-verbal, vocal, non-vocal, sender, Receiver, en-coding, decoding, noise, context, emotional maturity, relationships, etc. • Language, perception, • Non-verbal, body language, physical appearance, cultural differences etc. • Personal and interpersonal skills / perceptions. • Communication dilemmas and problems • Public Speaking – speaking situation, persuasion, • Making presentations, • Interviews • Business Writing: <ul style="list-style-type: none"> ○ Formal / Business letters, e-mails: a) job applications and resumes/ cv, b) enquiries, c) complaints / adjustments, d) orders, e) quotations, f) banking etc. ○ Memos: layout, language, style ○ Meeting management: notice, agenda, conducting / participating, writing minutes. ○ Contracts and agreements (basic theoretical knowledge and comprehension), ○ Research / scientific reports: types, structure, layout / presentation, writing process etc. ○ Tenders (basic theoretical knowledge and comprehension) • Engineering / Business Ethics: <ul style="list-style-type: none"> • Need and objectives for code of ethics and its importance • Type of ethics, involvement and impact in daily life • Problems / conflicts / dilemmas in application (case studies) • Sexual Harassment / discrimination in the workplace <ul style="list-style-type: none"> ○ why it occurs, ○ myths regarding sexual harassment, ○ how to deal withit, ○ gender equality, ○ respect etc. <p>Codes of conduct:</p> <ul style="list-style-type: none"> • Pakistan Engineering Council • Code for Gender Justice, • Brief study of other codes of conduct. • Lesikar& Pettit,<i>Report writing for Business</i>,McGraw Hill 		

Third Year (Spring Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-304 Food Microbiology	TE Spring Semester	3+1
COURSE TOPICS		
<p><u>The scope and development of food microbiology:</u> Microorganisms in food, food spoilage/preservation, food safety. Micro-organism in atmosphere, soil, air, water, equipments, plants and animal, raw meat, raw and pasteurized milk, vegetables fruits and nuts, canned foods, sugars and confectionaries, soft drinks etc.</p>		
<p><u>Microbial Metabolism of Food Components:</u> Metabolism of food carbohydrates, fermentation, anaerobic aerobic respiration, metabolism of food proteins, metabolism of food lipids.</p>		
<p><u>Factors affecting the Growth and Survival of Micro-organism:</u> Intrinsic factors: pH, moisture contents, oxidation reduction potential, nutrient content. Extrinsic factors: temperature of storage, concentration of gases, humidity.</p>		
<p><u>Microbial Spoilage and Examination of Food:</u> Spoilage: Spoilage of various foods causes of spoilage, types of spoilage. Examination: Sampling, microbial test procedures, indicator organisms, food poisoning organisms, food spoilage organisms.</p>		
<p><u>Bacterial and Non-bacterial Agents of Food Borne Illness:</u> Aeromonashydrophilia, Bacillus cereus and other species, Brucella, Compylobacter, Clostridium botulinum, Clostridium perfringens, Listeria monocytogenesis, Mycobacterium species, PlesiomonasShigelloids, Samonella, Shigella, Vibrio, Yersinia, Enterocolitica, Scombrotoxic fish poisoning. Helminths and Nematodes, Protozoa, Toxigenic algae and fungi, food borne viruses, Spongiform encephalopathies.</p>		
<p><u>Beneficial activities of microbes in food:</u> Fermented and microbial food; yeast, lactic acid bacteria, fermented milks, cheese, fermented vegetable and meats.</p>		
<p><u>Controlling the Microbiological Quality of Food:</u> Food preservation, microbial control.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-307 Heat and Mass Transfer	TE Spring Semester	3+1
COURSE TOPICS		
<p><u>Introduction</u> Overview, Energy transfer and energy balance for closed & for steady-flow systems, surface energy balance, heat transfer mechanisms, 1-d heat conduction and its cases, general heat conduction equation, boundary and initial conditions, solution of one dimensional heat conduction problems, heat generation in solids.</p>		
<p><u>Steady Heat Conduction</u> Steady heat conduction in plane walls, thermal contact resistance, generalize thermal resistance networks, heat conduction in cylinders and spheres, critical radius of insulation, finned surfaces, heat transfer in common configurations.</p>		
<p><u>Transient Conduction</u> Lumped system analysis, transient heat conduction with spatial effects in large plane walls, long cylinders and in spheres.</p>		

Numerical Methods in Heat Conduction

Need for numerical techniques, finite difference formulations for differential equations.

Fundamentals of Heat Convection

Physical mechanisms of convection, velocity and thermal boundary layer, derivation of differential convection equation.

External Forced Convection

Drag force & heat transfer in external flow, flow over flat plates, flow across cylinders, spheres & tube banks.

Fundamentals of thermal radiation

Thermal radiation, blackbody radiation, atmospheric and solar radiation.

Radiation Heat transfer

The view factor and its relations, black and diffused grey surfaces.

Heat Exchangers

Types of heat exchangers, heat transfer coefficient, analysis of heat exchangers, log mean temperature difference.

Introduction to mass transfer

Analogy b/w heat & mass transfer, mass diffusion, boundary conditions, steady mass diffusion through wall, mass convection.

Boiling and condensation

Boiling heat transfer, pool boiling, flow boiling, condensation heat transfer.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-308 Unit Operations in Food Engineering-II	TE Spring Semester	3+1
COURSE TOPICS		
<u>Humidification and Cooling Towers:</u> Wet-bulb and adiabatic saturation temperature; Cooling Towers types, features, outline design.		
<u>Drying:</u> General principles, Rate of drying, Diffusion and Capillary drying, Classification and selection of dryers.		
<u>Distillation:</u> The fractionating column. Calculation of number of plates required for binary separations. Lewis-Sorel, McCabe-Thiele methods. Column Design diameter and height.		
<u>Absorption:</u> Extension of design techniques. Wetted wall columns and determination of transfer coefficients. Equipments for gas absorption.		
<u>Liquid-Liquid Extraction:</u> Introduction, Extraction Processes, Extraction equipment.		
<u>Leaching:</u> General principles, Factors influencing the rate of extraction.		
<u>Adsorption:</u> The nature of adsorbents, Adsorption equilibria. Adsorption equipments and regeneration of spent adsorbents.		

Crystallization:

Growth and properties of crystals, saturation and nucleation, crystallization rate, impurities, effect of temperature on solubility.

Membrane separation:

General theory of separations based upon equilibrium and rate processes. Theory, design and analyses of ion exchange processes along with industrial applications.

Evaporation:

Single effect and multiple effect evaporators.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
BF-303 Applied Economics for Engineers	TE Spring Semester	3+0
COURSE TOPICS		
<u>Introduction:</u>		
Basic concepts and principles of economics, micro & macro economic theory, the problem of scarcity, basic concepts of engineering economy, financial effectiveness and non monetary factors.		
<u>Economic Environment:</u>		
Consumer and producer goods; goods and services, demand and supply concept, market equilibrium, elasticity of demand and supply, measure of economic worth, price supply-demand relationship, revenue, cost and profit function.		
<u>Basic Cost Concept and Break Even Analysis:</u>		
Types of cost and cost curves (fixed cost, variable cost, average cost, marginal cost, total cost....) determination of costs/ revenue, numerical and graphical presentation, practical application, BEA as a management tool for achieving financial / operational efficiency.		
<u>Elementary Financial Analysis:</u>		
Basic accounting equation, development and interpretation of financial statements (income statement, balance sheet).		
Cash flow, working capital management, financial ratio analysis		
a) Time value of money and financial returns:		
Concept of simple, compound and effective interest rate, less often then compounding period and more often than once year, present value, future value and annuities concepts, uniform gradient and geometric sequence of cash flow.		
b) Project selection and comparing Alternatives Techniques:		
Net present value, annual worth analysis, internal rate of return, benefit cost ratio analysis, pay back period.		
<u>Depreciation and Taxes:</u>		
Depreciation concept, economic life, methods of depreciations (straight line, SYD approach, declining balance, etc), gain (loss) on the disposal of asset, depreciation as tax shield.		
<u>Business Organizations and Financial Institutions:</u>		
Types of ownership, single ownership, partnership corporation, types of stock, joint stock companies, banking and specialized credit institution.		
<u>Introduction to Production Management to Production Concept):</u>		
Basic production function, stages of production, returns to scale, production lead time, production rate, capacity, operations, planning and control, order processing, scheduling, material requisitions planning, line of balance.		
<u>Linear Programming:</u>		
Mathematical statement of LP problem, graphical solution, simplex method, duality problem.		

COURSE CODE/TITLE MT-442 Numerical Method	SEMESTER/TERMS OFFERED TE Spring semester	CREDITS 3+0
<p>COURSE TOPICS</p> <p><u>Error Analysis</u> Types of errors (relative, Absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions.</p> <p><u>Linear Operators</u> Functions of operators, difference operators and the derivative operators, identities.</p> <p><u>Difference Equations</u> Linear homogeneous and non homogeneous difference equations.</p> <p><u>Solution of Non-linear Equations</u> Numerical methods for finding the roots of transcendental and polynomial equations (Secant, Newton – Raphson Chebyshev and Graeffe's root squaring methods), rate of convergence and stability of an iterative method.</p> <p><u>Solution of Linear Equations</u> Numerical methods for finding the solutions of system of linear equations (Gauss-Elimination, Gauss-Jordan Elimination, triangularization, Cholesky, Jacobi and Gauss – Seidel).</p> <p><u>Interpolation &- Curve Fitting</u> Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curves).</p> <p><u>Numerical Integration & Differentiation</u> Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 3/8th Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, RungeKutta method of order 4). Numerical Solutions of Partial differential Equations, Optimization problem (Simplex Method). Steepest Ascent and Steepest Descent Methods.</p>		

Fourth Year (Fall Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-402 Food Quality Control	BE Fall semester	3+0
<p>COURSE TOPICS</p> <p><u>Definition of Quality:</u> Quality assurance, total quality concepts; evolution of quality activities in the history.</p> <p><u>Principles of total Quality Management:</u> Quality Management System and ISO-9000 standards; functions of Quality Assurance Department and its relations with other departments.</p> <p><u>Description of Critical Control Points:</u> HACCP, GMP systems; classification of food quality attributes; definition and objective evaluation of sensory food attributes, sensory test techniques.</p> <p><u>Nutritional Quality Control:</u> Approximate analysis of foods; statistical quality control tools.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-410 Food Processing	BE Fall Semester	3+0
<p>COURSE TOPICS</p> <p><u>Processing/Preservation Technologies:</u> Blanching, Fermentation, Canning, Dehydration, Extrusion, Chilling, Freezing, Aseptic processing, Sterilization, Pasteurization, Ohmic heating.</p> <p><u>Preservation concerns in Food Processing:</u> Food packaging fundamentals, Food Toxicology, Environmental hazards.</p> <p><u>Sanitation and Quality:</u> Food Plant Sanitation Requirement: Sanitation, need for a sanitation program, Sanitizers, Pest Control, Quality Assurance.</p> <p><u>Product Development:</u> Product development basics, sensory evaluation of foods.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-419 Process Control in Food Industry	BE Fall Semester	3+0
<p>COURSE TOPICS</p> <p><u>Introduction to Process control:</u> Importance of Process Control in the Food industry: Importance; introduction to process control principles; definition of control objectives. Feedback and Feed forward Control systems. Types of control scheme, (Proportional, Integral, Derivative and PID) Controllers.</p> <p><u>Mathematical Modeling:</u> Basics of mathematical modelling; process control elements; definition of open and closed loop systems; transfer functions and block diagrams.</p> <p><u>Process control arrangement in different food processes:</u> Bioreactors, pasteurization and sterilization, drying, freezing, evaporation.</p>		

Fourth Year (Spring Semester) Food Engineering

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-408 Food Regulations and Legislation	BE Spring Semester	2+0
<p>COURSE TOPICS</p> <p><u>Pakistan Standards:</u> Standards and Quality Control Authority: functions, authorities.</p> <p><u>Pure Food Rules:</u> Background, definitions, significant features, enforcement, amendments; Food inspector and public analyst: qualifications, duties, powers.</p> <p><u>Food Adulteration:</u> Adulterants, health hazards, methods of detection.</p> <p><u>Food Labelling:</u> Perspectives on nutrition labeling; Islamic food laws and regulations: sources, principles, lawful foods, unlawful foods; Consumer laws in Pakistan.</p> <p><u>International Food Laws:</u> Introduction; The World Trade Organization (WTO) - the agreement on the application of sanitary and phytosanitary measures; GATT; Codex Alimentarius: general, procedural manual, standards, codes, legal force.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-411 Food Plant Layout and Design	BE Spring semester	2+1
<p>COURSE TOPICS</p> <p>Plant design and layout: Objectives and functions, financial requirements, plant location, site selection, space requirement, building design and construction, floors, drains, walls, doors, windows, ceiling, ventilation, lighting, auxiliary facilities. Food plant equipment, layout of equipment, requirements, design, construction, choice of material.</p> <p>Selection of novel products from food industry through market survey, food product development. Selection of the local preparation of the plant layout, material and energy balances. Design of the major units and sizing, auxiliary equipment including services, health and safety considerations, plant and product cost estimation.</p> <p>Use of computer for layout, environmental impact, material handling and equipment process flow chart.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-420 Fundamentals of Food Packaging	BE Spring semester	3+1
<p>COURSE TOPICS</p> <p>Introduction of food packaging: Introduction to conventional and modern food packaging, importance and functions of packaging, elements of successful packaging</p> <p>Packaging materials and their processing Introduction to packaging materials: polymers (plastics), paper, glass and metals. Selection criteria of packaging materials for different food products, processing of packaging materials for food</p>		

applications, Industrially preferred manufacturing processes of food packaging products such as injection moulding, extrusion, blow moulding, sheet and film extrusion, paper and paperboard calendaring, lamination, steel drawn cans processes. Fresh and frozen food packaging systems (meat, poultry, sea food, fruits and vegetables, dairy products).

Recent trends in food packaging:

Active, Controlled atmosphere (CA), Modified atmosphere (MA), Anti-microbial, Edible, Aseptic and biodegradable packaging

Packaging equipment and machinery:

Vacuum, Seal and shrink packaging machine. Form & fill sealing machine, Aseptic packaging systems, Retort pouches, Bottling machines, Carton making machines, Package printing machines.

ELECTIVES

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-403 Food Biotechnology	Electives	2+1
<p>COURSE TOPICS</p> <p><u>Biotechnology:</u> Introduction, history.</p> <p><u>Microbial Metabolism:</u> Developments in metabolic and biochemical engineering: metabolites, range of fermentation processes, components of fermentation processes; Isolation and preservation of industrially important microorganisms.</p> <p><u>Industrial Fermentations:</u> Media, design and types of fermentors, process variables in fermentation, recovery, purification of fermentation products; Production of organic acids, enzymes, amino acids, single cell proteins, carotenoids and fermented food products.</p> <p><u>Microbial Genetics:</u> Conjugation, transduction, transformation; Legal and social aspects of food biotechnology.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-404 Sugar & Confectionery	Electives	2+1
<p>COURSE TOPICS</p> <p><u>Sugar Industry in Pakistan:</u> Composition and properties of Molasses Sugarcane and sugar beet and honey: production, quality; Indigenous technology for small scale sugar production: <i>gur, khund, shaker</i>; Raw sugar manufacturing: unit operations, Bagging, storage; Factors affecting sugar processing; Quality criteria: raw and refined sugar; Specialty sugar products: brown or soft sugar, liquid sugar; Sugar industry byproducts and their uses.</p> <p><u>Nutrition Value:</u> Caloric and non-caloric sweeteners; Nutritional Value, Sweetening Power, Processing, Toxicology and Safety. Packaging, By-products and their Utilization. Quality Control. Non-Nutritive Sweeteners.</p> <p><u>Confectionery:</u> Significance, classification, industries in Pakistan. Ingredients, manufacturing - high boiled sweets, caramel, toffee, fudge, gums.</p> <p><u>Sugar free Confectionery:</u> Need, ingredients, manufacture; Chewing gum technology; Chocolate confectionery.</p> <p><u>Snack Foods:</u> History, manufacture - potato, nuts, cereal, meat and fish based; Puffed and baked snacks.</p> <p><u>Seasonings:</u> Ingredients, formulations, applications; Quality control; Packaging.</p>		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-409 Postharvest Technology	Electives	2+1
COURSE TOPICS		
<u>Introduction:</u> Production, losses, causes, trade.		
<u>Fruit Ripening:</u> Changes during ripening, recommended conditions, commercial practices, water loss, respiration activity; Harvesting and handling methods; Maturity assessment of different fruits and vegetables.		
<u>Ripening Process:</u> Respiration, climacteric and non-climacteric patterns, pectic substances, ripening conditions; Postharvest physiology of fruits and vegetables; Postharvest treatments: coatings, curing, vapor heat treatment, hot water treatment, degreening; Storage: refrigerated, CA, hypobaric, MAS.		
<u>Packaging:</u> Types, design, modified atmospheric packaging, recycling.		
<u>Cold Chain:</u> Packing house operations, transportation; Safety and quality of fruits and vegetables;		
<u>Postharvest Technology of Cereals:</u> Harvesting, threshing, drying, storage and handling; New developments in postharvest technology.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-412 Dairy Processing	Electives	2+1
COURSE TOPICS		
<u>Milk:</u> Production statistics, importance, standards, major constituents; Factors influencing raw milk quality.		
<u>Milk Handling:</u> Manual and machine milking, farm cooling, collection, reception, analyses at different levels, transportation.		
<u>Unit Operations in Milk Processing:</u> Cream separation, bacto-fugation, filtration, thermization, standardization, homogenization, pasteurization, sterilization, UHT, aseptic packaging, storage, distribution, effect on milk constituents.		
<u>Technology:</u> Chemistry, microbiology of industrial products and quality control: evaporated, condensed and powder milks, butter, yogurt, cheese, ice cream, <i>khoa</i> , <i>gulabjamun</i> , <i>burfi</i> , <i>rabri</i> , <i>paneer</i> , <i>dahi</i> , <i>lassi</i> , <i>kheer</i> , <i>desi ghee</i> ; Milk by-products: dried whey, casein.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-413 Cereal Processing	Electives	2+1
COURSE TOPICS		
<u>Cereal Grains:</u> importance, production, structure, composition, nutrition: Grain grades and grading; Storage: methods, types, role of temperature and moisture, safe storage methods; Dry milling process: cleaning, tempering, conditioning;.		
<u>Grinding and Sieving:</u> Types of grinding machines; Sieving process: principles, types of sifters; Flour treatment and quality assessment; Rheology of doughs and batters. Maize - wet milling: production of starch, oil, protein. Rice: Drying, milling, parboiling; Processing of rice and oats; Malting and brewing; Production of breakfast cereals and snack foods; Feed and industrial uses of cereals.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-414 Beverage Processing	Electives	2+1
COURSE TOPICS		
<u>Beverage industry in Pakistan:</u> Beverages: classification – still, carbonated, alcoholic; Beverage ingredients: water, fruit components, sweeteners, flavorings, colorings, preservatives; Manufacture of soft drinks and fruit juices: mixing, pasteurization, homogenization, filling, packing and storage.		
<u>Carbonation:</u> History, CO ₂ , gas volume; Soft drinks and fruit juices: ingredient specifications, manufacturing problems, changes in color, appearance, flavor;		
<u>Packaging Types:</u> Interactions; Shelf life Issues: microbiological problems; Bottled water: legislation, water treatment, filling, quality issues; Fermented beverages: introduction, types, role of microorganisms.		
<u>Regulations and Standards:</u> Statutory requirement: labeling, nutrition claims.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-415 Meat, Poultry and Egg	Electives	2+1
COURSE TOPICS		
<u>Poultry industry in Pakistan:</u> Factors affecting poultry quality: breed, age, sex, genotype, rearing conditions and practices; Bird selection: weight, quality; Primary poultry processing: live-bird, stunning, slaughtering, scalding, plucking, evisceration, giblet harvesting, whole-carcass and cuts packaging; Portioning and deboning operations; Preservation: freezing, canning, drying, chemical treatments, irradiation.		
<u>Packaging:</u> Materials, selection; Quality assurance: parameters, drug and feed residues.		
<u>Eggs:</u> Identification, grading, composition, quality characteristics, handling, storage; Egg processing: drying, freezing - whole, white, yolk; Functional properties and applications in food processing; Quality control during processing.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-416 Food Product Development	Electives	2+1
COURSE TOPICS		
<u>Process:</u> Food product development: strategy, design, development, commercialization, evaluation; Key to new product success and failure.		
<u>Consumer Trends:</u> Food product development: consumer behavior, food choices, sensory needs, consumer role; Preference mapping and food product development: conducting trials, analyzing, recent developments; Case study of consumer-oriented food product development: reduced-calorie foods - healthy eating, marketing and technological challenges, success factors; Case study: reduced -calorie on-the-go beverages; The ethics of food production and consumption. Genemically Modified food.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-417 Oil and Fat Processing	Electives	2+1
COURSE TOPICS		
<u>Physical and Chemical Characteristics:</u> Oils and fats: importance, sources, production, uses; Characteristics of oils and fats. Oil bearing materials: pre-treatment, storage.		
<u>Extraction Methods:</u> Rendering, expression, solvent extraction; Processing: degumming, refining, bleaching, deodorization, fractionation, winterization, hydrogenation, interesterification, esterification, emulsification, stabilization; Spoilage: oxidative and hydrolytic rancidity – chemistry, prevention - use of antioxidants; Manufacture of frying oils, margarine, mayonnaise; Byproducts of fats and oils industry and their uses.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
FD-418 Food Plant Hygiene and Sanitation	Electives	2+1
COURSE TOPICS		
<u>Food Sanitation:</u> Importance of sanitation in food industry; Introduction to Hazard Analysis and Critical Control Points (HACCP).		
<u>Practices:</u> Food processing systems; sanitation standard operating procedures (SSOP); cleaning compounds; sanitizers; pest control; waste product handling.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
CH-405 Industrial Safety and Maintenance Management	Electives	2+1
COURSE TOPICS		
Introduction: Accident and loss statistics, public perception of chemical industry, the accident process, some significant disasters as case studies; Toxicology: how toxicants enter and are eliminated from biological organisms, effects of toxicants, dose versus response models, threshold limit values.		
Industrial Hygiene: Government regulations, identification and evaluation and control of various exposures in chemical industry. Fires and explosions: fire triangle, flammability characteristics of liquids and vapors. Design to prevent fires and explosions. Hazard identification and risk assessment. Accident investigations and case histories.		

Forms of maintenance, scheduling of maintenance. Computerized Maintenance. Non destructive testing techniques. Forms of corrosion, prevention and inhibition,; Preparation for startup and shutdown. Preventive and predictive maintenance.

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
CH-407 Industrial Organization and Management	Electives	3+0
COURSE TOPICS		
Introduction and History, Company and Organization, Facility Location and Layout Planning, Operation Planning and Control, Marketing and Distribution, Total Quality Management, Project Management, Maintenance Management, Financial Management, Human Resources, Other Topics and Recent Trends in Management.		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
MG-228 Sociology & Development	Electives	2+0
COURSE TOPICS		
Introduction to Sociology		
<ul style="list-style-type: none"> • Foundations of OB: Management functions, roles, and skills • Definition, nature, scope, and importance of Sociology • Study of social life; exploring the global village • Sociology as a science; relationship with other social sciences • The sociological imagination; development of Sociology, pioneers of Sociology • The sociological imagination; development of Sociology, pioneers of Sociology • Brief historical development of Sociology • Society and community, Social interaction processes 		
Social groups & Social Institutions		
<ul style="list-style-type: none"> • Definition, functions and types of social groups • Structure and function of social institutions • Inter-relationships among various social institutions 		
Culture and Related Concepts		
<ul style="list-style-type: none"> • Definition, types and elements of culture • Role of culture in organization • Socialization and personality 		
Social Stratification		
<ul style="list-style-type: none"> • Factors of Social Stratification • Approach to study social stratification • Power, Prestige, and Authority • Social Mobility; Migration 		
Social and cultural change		
<ul style="list-style-type: none"> • Definition of social change • Dynamics of social change • Impact of globalization on society and culture • Resistance to change 		
Sociology & Development		
<ul style="list-style-type: none"> • Significant sociological questions • Measures of inequality and development • Modernisation theory and explanation of underdevelopment • Education, industrialization & development 		

COURSE CODE/TITLE	SEMESTER/TERMS OFFERED	CREDITS
HS-219 Professional Ethics	Electives	2+0
COURSE TOPICS		
Introduction to Professional & Engineering Ethics:		
<ul style="list-style-type: none"> • Definitions: Ethics, professional Ethics, Engineering Ethics, Business Ethics • Ethics & Professionalism Need and scope of Engineering and professional Ethics through Case Studies • Development of Engineering Ethics & Major issues in Engineering & Professional Ethics 		
Moral Reasoning & Ethical Frameworks Ethical Dilemma:		
<ul style="list-style-type: none"> • Resolving Ethical dilemmas and making Moral Choices Codes of Ethics (of local and international professional bodies) • Moral Theories: Utilitarianism, Rights Ethics and Duty Ethics, Virtue Ethics Self- Realization & Self Interest • Ethical Problem Solving Techniques: Line drawing, flow Charting, Conflict Problems. Case Studies and applications 		
Contemporary Professional Ethics:		
<ul style="list-style-type: none"> • Professional Responsibilities • Risk and Safety as an Ethical Concern for Engineers • Workplace Responsibilities and Ethics: Teamwork, confidentiality and conflicts of interest, Whistleblowing, Bribe and gift, risk and cost-benefit analyses, gender discrimination and sexual harassment • Environmental Ethics Computer Ethics & the Internet Honesty: Truthfulness, trustworthiness, academic and research integrity 		