

## **CURRICULAR LAYOUT FOR THE DEGREE OF B.Sc. FOOD ENGINEERING**

### **LEVEL-1, SEMESTER-1**

Sl. No.	Course No.	Course Title	Credit	Contact Hours
1	CSM 111	Mathematics I	3	3
2	PHY 111	Physics	3	3
3	PHY 112	Physics	1	2
4	CHEM 111	Chemistry	3	3
5	CHEM 112	Chemistry	1	2
6	FS 112	Engineering Drawing (Civil)	1	2
7	LAN 101	English	2	2
8	CBOT 101	Crop Botany	1	1
9	CBOT 102	Crop Botany	1	2
10	ACH 111	Agro-Industrial Chemistry	2	2
11	ACH 112	Agro-Industrial Chemistry	1	2
		<b>Total</b>	<b>19</b>	<b>24</b>

### **LEVEL-1, SEMESTER-2**

Sl. No.	Course No.	Course Title	Credit	Contact Hours
1	CSM 121	Mathematics II	3	3
2	CSM 123	Computer Science	2	2
3	CSM 124	Computer Science	1	2
4	FPM 121	Workshop Technology	1	1
5	FPM 122	Workshop Technology	1	2
6	FPM 124	Engineering Drawing (Mechanical)	1	2
7	FPM 125	Engineering Mechanics	3	3
8	FS 121	Surveying	2	2
9	FS 122	Field Surveying	1	2
		<b>Total</b>	<b>15</b>	<b>19</b>

### **LEVEL-2, SEMESTER-1**

Sl. No.	Course No.	Course Title	Credit	Contact Hours
1	CSM 211	Mathematics III	3	3
2	CSM 213	Computer Application	2	2
3	CSM 214	Computer Application	1	2
4	FTRI 211	Food Science	2	2
5	FTRI 212	Food Science	1	2
6	IWM 211	Fluid Mechanics	2	2
7	IWM 212	Fluid Mechanics	1	2
8	FPM 211	Thermodynamics	2	2
9	FPM 212	Thermodynamics	1	2
10	RS 211	Rural Sociology	2	2
11	AEC 211	Agricultural Economics	2	2
12	HORT 211	Horticulture Science	2	2
13	HORT 212	Horticulture Science	1	2
		<b>Total</b>	<b>22</b>	<b>27</b>

### **LEVEL-2, SEMESTER-2**

Sl. No.	Course No.	Course Title	Credit	Contact Hours
1	FPM 221	Electrical Engineering	2	2
2	FPM 222	Electrical Engineering	1	2
3	FPM 223	Heat Engines	2	2
4	FPM 224	Heat Engines	1	2
5	FS 221	Strength of Materials	2	2
6	FS 222	Strength of Materials	1	2
7	STAT 221	Statistics	2	2
8	STAT 222	Statistics	1	2
9	FS 223	Engineering Materials and Cost Estimation	2	2

10	FS 224	Engineering Materials and Cost Estimation	1	2
11	FTRI 221	Fundamental of Food Engineering	2	2
12	FTRI 222	Fundamental of Food Engineering	1	2
13	IWM 221	Hydraulics	2	2
14	IWM 222	Hydraulics	1	2
<b>Total</b>			<b>21</b>	<b>28</b>

### LEVEL-3, SEMESTER-1

Sl. No.	Course No.	Course Title	Credit	Contact hours
1	FTRI 311	Unit Operations in Food Engineering	2	2
2	FTRI 312	Unit Operations in Food Engineering	1	2
3	BCHEM 311	Biochemistry	2	2
4	BCHEM 312	Biochemistry	1	2
5	VMH 315	General Microbiology	2	2
6	VMH 316	General Microbiology	1	2
7	FTRI 313	Food Packaging and Machinery	2	2
8	FPM 313	Electrical Machinery	2	2
9	FPM 314	Electrical Machinery	1	2
10	FS 315	Food Factory and Storage Buildings	2	2
11	FS 316	Food Factory and Storage Buildings	1	2
12	CM 305	Accountancy	2	2
<b>Sub total</b>			<b>19</b>	<b>24</b>

**Optional Course<sup>1</sup> : Two credits from the following courses:**

Sl. No.	Course No.	Course Title	Credit	Contact hours
1	FTRI 315	Renewable Energy in Food Processing	2	2
2	LAN 311	Technical Communication in English	2	2
<b>Total</b>			<b>19</b>	<b>24</b>

<sup>1</sup>No credit shall be added for optional courses in CGPA calculation but the result shall be shown on the student's transcript by letter grades.

### LEVEL-3, SEMESTER-2

Sl. No.	Course No.	Course Title	Credit	Contact hours
1	FTRI 321	Food Chemistry	2	2
2	FTRI 322	Food Chemistry	1	2
3	FTRI 323	Food Microbiology	2	2
4	FTRI 324	Food Microbiology	1	2
5	Ag.Ext 321	Agricultural Extension Education	2	2
6	Ag.Ext 322	Agricultural Extension Education	1	2
7	FPM 327	Refrigeration and Air Conditioning Engg.	2	2
8	FPM 328	Refrigeration and Air Conditioning Engg.	1	2
9	FPM 325	Heat and Mass Transfer	2	2
10	FPM 331	Mechanical Design of Process Equipment	2	2
11	FPM 332	Mechanical Design of Process Equipment	1	2
<b>Sub total</b>			<b>17</b>	<b>22</b>

**Elective Courses: Two Credits from the following courses:**

Sl. No.	Course No.	Course Title	Credit	Contact hours
1	FTRI 325	Tea, Coffee, Cocoa and Spices Technology	2	2
2	FTRI 327	Food Machinery Manufacture and Maintenance	2	2
3	FTRI 329	Waste Treatment and Utilization in Food Industry	2	2
4	FS 321	Environmental Engineering	2	2
5	FTRI 331	Biochemical Engineering	2	2
6	FTRI333	Report and Proposal Writing	2	2
7	FTRI 335	Food Irradiation	2	2
<b>Total</b>			<b>17+2=19</b>	<b>24</b>

**LEVEL-4, SEMESTER-1**

Sl. No.	Course No.	Course Title	Credit	Contact hours
1	CSM 405	Electronics and Instrumentation	2	2
2	CSM 406	Electronics and Instrumentation	1	2
3	FTRI 401	Food Analysis and Nutrient Technology	3	3
4	FTRI 402	Food Analysis and Nutrient Technology	1	2
5	CM 417	Agribusiness and Marketing	2	2
6	FTRI 403	Post-harvest Technology of Agricultural Produce-I	2	2
7	FTRI 405	Food Plant Design, Layout and Management	2	2
8	FTRI 410	Project Work and Seminar	1	2
<b>Sub total</b>			<b>14</b>	<b>17</b>

**Elective Courses: Six credits (four courses) from the following courses:**

Sl. No.	Course No.	Course Title	Credit	Contact Hours
1	FTRI 406	Food Technology-I	1	2
2	FTRI 407	Beverage and Fermentation Technology	2	2
3	FTRI 409	Baking and Confectionery Technology	2	2
4	FTRI 411	Dairy Engineering	2	2
5	FTRI 413	Safety and Sanitation in Food Industry	2	2
6	FTRI 415	Handling and Storage of Horticultural Crops	2	2
7	FTRI 416	Food Technology –II	1	2
8	FTRI 417	Technology of Fats and Oils	2	2
9	AS 413	Animal Science	2	2
10	AS 414	Animal Science	1	2
11	DS 415	Dairy Science	2	2
12	DS 416	Dairy Science	1	2
13	FT 413	Fish Processing	2	2
14	FT 414	Fish Processing	1	2
15	FPM415	Agricultural Machinery	2	2
16	FPM416	Agricultural Machinery	1	2
17	FPM417	Rural Electrification Engineering	2	2
18	FPM418	Rural Electrification Engineering	1	2
19	CSM402	Computer Aided Design	1	2
<b>Total</b>			<b>14+6=20</b>	<b>25</b>

**LEVEL-4, SEMESTER-2**

Sl. No.	Course No	Course Title	Credit	Contact Hours
1	FTRI 421	Food Process Engineering	2	2
2	FTRI 422	Food Process Engineering	1	2
3	FPM 421	Engineering Management	2	2
4	FTRI 423	Quality Control in Food Industry	2	2
5	FTRI 424	Quality Control in Food Industry	1	2
6	FTRI 425	Post-Harvest Technology of Agricultural Produce-II	2	2
7	FTRI 426	Post-Harvest Technology of Agricultural Produce-II	1	2
8	FTRI 427	Engineering Properties of Food Materials	2	2
9	FTRI 428	Training in Food Industry	1	-
10	FTRI 430	Project Work and Report	3	6
<b>Sub total</b>			<b>17</b>	<b>22</b>

**Elective Courses: Three credits from the following courses:**

Sl. No.	Course No	Course Title	Credit	Contact Hours
1	FTRI 431	Sugar Engineering	2	2
2	FTRI 432	Sugar Engineering	1	2
3	FTRI 433	Food Engineering Systems	3	3
4	CSM 437	GIS and ICT	2	2
5	CSM 438	GIS and ICT	1	2
6	Ag.Ext 429	Extension Communication Management	3	3
<b>Total</b>			<b>17+3=20</b>	<b>25</b>

**Grand Total of Credits required for the Degree: 155**

**Note:** The odd and even numeric figures in the course code indicate theory and practical courses, respectively

# FOOD ENGINEERING

## SYLLABUSES FOR THE B.Sc. FOOD ENGINEERING COURSES

<b>CSM 111 Mathematics-I</b>	<b>Credit-3</b>
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Differential Calculus: Review: function. Leibnitz's theorem; expansion of functions; Rolle's theorem; mean value theorem; Taylor's theorem and Maclaurin's theorem (proof not required); maxima and minima for functions of one and two variables; point of inflexion; partial differentiation; Euler's theorem; applications of partial differentiation; tangent; normal and curvature in Cartesian co-ordinates. Integral Calculus: Review of indefinite integrals; definite integrals; properties of definite integrals; gamma and beta functions; integration by reduction. Matrices: Introduction; transpose of matrix; adjoint and inverse of a matrix; singular and non-singular matrix.

<b>PHY 111 Physics</b>	<b>Credit- 3</b>
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General Properties of matter: Elasticity, surface tension and viscosity. Heat and Thermodynamics: First law of thermodynamics and its applications, different kinds of thermo- dynamical changes, interrelation between pressure, volume and temperature. Second law of thermodynamics; reversible and irreversible processes, heat engine and Carnot's cycle. Electricity and Magnetism: Current and resistance, Kirchhoff's laws on distribution of current. Magnetic induction due to current, Ampere's law, Biot-Savart law. Electromagnetic induction, Henry-Faraday's law, inductance, L-R circuits. Nuclear Physics and Electronics : Nuclear physics- Atomic and nuclear structure, radioactivity, decay law, half life, nuclear fission and fusion, uses of radio isotopes.

<b>PHY 112 Physics</b>	<b>Credit-1</b>
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Determination of Y (Young's modules) by Searle's method. Determination of modulus of rigidity by dynamic method. Determination of 'g' by Kater's pendulum. Determination of surface tension by capillary rise. Comparison of magnetic moments of two bar magnets in tan A and tan B position by deflection method.. Comparison of magnetic moments of two bar magnet by null method. Determination H by Vibration magnetometer. Determination of refractive index of liquid by a plane mirror and a convex lens. Verification of laws of combination of resistance by P.O. Box.

<b>CHEM 111 Chemistry</b>	<b>Credit-3</b>
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Chemical equilibrium: Law of mass action and its application in homogenous and heterogenous reactions. Electrochemistry : Ionic equilibrium, Ostwald's law, common ion effect, electrolytic dissociation and conductance theories of strong electrolyte, pH, Buffer solution and its preparation, indicator, solubility product, principles of precipitation. Preparation of solution: Colligative properties of dilute solutions. Colloids: Preparation, properties and uses of colloids. Colorimetric analysis : Lambert's and Beer's law and their applications. Production of urea from natural gas. Petroleum refining and uses of different fractions. Environmental chemistry and pollution: Aromatic and heterocyclic compounds. Carbohydrates: Chemistry of monosaccharide and disaccharides.

<b>CHEM112 Chemistry</b>	<b>Credit-1</b>
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Preparation of standard solution of different compounds like  $\text{Na}_2\text{CO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{C}_2\text{O}_4$  and  $\text{KMnO}_4$  Acid-base titration, redox titration, complexometric titration. Identification of organic compounds and their functional groups: Oxalic, citric, tartaric, acetic, formic acid, glucose, urea and carbonyl compounds

<b>FS112 Engineering Drawing (Civil)</b>	<b>Credit-1</b>
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Introduction: History, Applications, Instruments, Lines, Arrows, Dimensions and Symbols Lettering: Definition, Types, Uses, Single and Double stroke lettering. Scale: Definition, Types, Uses, Plane and Diagonal scale construction. Views: Definition, Types and Uses. Orthographic View: definition, Principles, Surfaces of solid sections, Drawing procedure and Uses. Isometric View: Definition, Drawing of solids, Orthographic views from . Isometric views and Uses. Building drawing: Foundation, Superstructure, Lintel with sunshade, Beam, Roof, Staircase, Construction plans and layouts of Farm house and Storage structure.

<b>LAN101 English</b>	<b>Credit- 2</b>
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Textual study and comprehension practice from a prescribed text. Socio-linguistic rules to perform language function in English. Basic grammatical structures: Types of constructional forms of sentences; Sequence of tense; Voice; Verbs; Verb

patterns and verb modifiers; Syntax; Combination of Sentences; Framing of question sentences. Nouns and determiners; Adjectives; Adverbial and repositional phrases. Mechanics: Punctuation; Quotation marks; Capitalisation. Principles and methods of composition.

<b>CBOT101 Crop Botany</b>	<b>Credit-1</b>
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Taxonomy: Concept, botanical nomenclature, principles, classification and objectives. External morphology: Vegetative and reproductive organs of plants, canopy concept and water requirement. Cell & Tissue: Structures and functions, classification, variation and maturation. Plant-water relationship: Concept of water potential and its significance, transpiration- types, mechanism, significance in relation to storage. Photosynthesis and Respiration: Sites, types, mechanisms, factors involved, significances during growth, harvest and storage. Fruits, Seeds and Storage organs: Formation and structures, types, biochemical changes during growth and ripening, physiological maturity, factors affecting viability and dormancy.

<b>CBOT102 Crop Botany</b>	<b>Credit-1</b>
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Study of different storage tissues, seeds and fruits. Study of effects of environmental factors on seed germination. Study of photosynthesis and respiration in plant materials. Determination of water potential in plant tissues. Determination of transpiration in different plant materials. Separation and determination of plant pigments Study of the following families: Gramineae, Leguminosae, Solanaceae, Anacardiaceae, Moraceae, Myrtaceae and Bromiliaceae

<b>ACH111 Agro-Industrial Chemistry</b>	<b>Credit- 2</b>
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Water Chemistry-source quality assessment and criteria for drinking and industrial uses. Colorimetry, flame emission and atomic absorption spectrophotometry. Environmental chemistry- environmental sources of toxic substances, such as pesticides their roots and metabolism and biochemical effects as food crops, chemical and photochemical reactions in the atmosphere. .Bio-energy-Concept, energy from agro-wastes generation of bio-gas and utilization of effluents, energy in sewage-sludge and fuels. Chemistry of Agro-industrial crops-Tea manufacturing process, change of chemical composition in tea leaves, aroma, tea infusion, and liquoring quality of tea. Pigments and flavour in Fruits and Vegetables-Carotinoids and flavonoids, their occurrence, role and changes on cooking and processing post harvest nutritional losses.

<b>ACH 112 Agro-Industrial Chemistry</b>	<b>Credit- 1</b>
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Instruction for the use of laboratory chemicals glasswares, and their safety measures. Analytical technique: Titrimetry, colorimetry, flame emission spectrophotometry, atomic absorption pectrophotometry and chromatography and operation of the analytical instrument. Water analysis for different elements with emphasis for heavy metals such as-As, Pb, Zn etc. Analyses of pesticide residues in food crops. Generation of bio-energy from agricultural waste. Identification of hazardous chemicals by pictograms. Analysis of fish and poultry feed.

<b>CSM121 Mathematics-II</b>	<b>Credit- 3</b>
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Differential Equations, derivation of differential equations from physical problems; solution of first order and first degree equations; second and higher orders with constant coefficients. Co-ordinate geometry, Numerical analysis: Finite difference; detection of errors by use of difference tables; Newton's formula for interpolation; interpolation with unevenly spaced points; Lagrange's interpolation formula; divided difference formula; numerical differentiation and integration; Trapezoidal rule; Simpson's rule; numerical solution of ordinary differential equations; Euler's method; modified Euler's method; Runge-kutta method.

<b>CSM123 Computer Science</b>	<b>Credit- 2</b>
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Computer fundamentals: computer systems, number systems and their internal representations, binary arithmetic's, information coding, introduction to digital circuits and their design. Programming fundamentals; control structures; variable modifiers; pointer variables; functions; arrays; characters and strings; structures; recursive functions; disc I/Os; introduction to data structures.

<b>CSM124 Computer Science</b>	<b>Credit-1</b>
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Familiarity with computer peripherals; use of different systems s/w; text processing. Program writing and terminal use based on CSM123.

<b>FPM121 Workshop Technology</b>	<b>Credit-1</b>
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Measurement concepts, Fits and tolerance, Measuring and gauging instruments, Nondestructive testing and inspection. Metal cutting methods, mechanics of metal cutting, metal cutting tools, cutting speed, feed and depth of cut, computing metal cutting

parameters. Metal Working Principles: Turning, Shaping, Planing, Drilling, Grinding, Welding and allied processes; Threads and thread cutting; Hot and cold working of metal. Basic Machine tools elements: Machine frame, Drive, Work-holding devices, Methods of feed and depth control. Machines: Lathe, shaper, milling, jigs and fixtures, grinding machine and planing machines.

<b>FPM122 Workshop Technology</b>	<b>Credit-1</b>
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Identification and use of various measuring and gauging instruments. Identification of various components, processes and operation of metal working machines. Cutting tool shaping and fitting. Cutting speed and feed, cutting time. Safety and protection in the workshop.

<b>FPM124 Engineering Drawing (Mechanical)</b>	<b>Credit-1</b>
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Orthographic drawing and sketching: Pictorial drawing & sketching, intersections and developments; dimensions, tolerances, fits and clearances, limits and precision; screw, threads and threaded fasteners; working drawings; drawing of jigs, fixtures, welded parts, gears and cams; sections of solids, conic sections, loci, spiral curves, log spirals, etc.; preparation of a complete dimensioned scale drawing of agricultural machinery and assemblies. Plan, elevation and cross-sectional view of solid objects.

<b>FPM 125 Engineering Mechanics</b>	<b>Credit- 3</b>
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*Statics:* Force systems: Force, moment, couple, resultant of forces. Equilibrium: Free body diagram, equilibrium conditions and its applications. Friction and frictional force systems, friction in machines. Centroids, center of mass, area and mass moment of inertia, product of inertia. Structures: Simple trusses, frames and machine, beams with concentrated and distributed loads.

*Dynamics:* Kinematics of particles: Rectilinear motion, plane curvilinear motion, different coordinates, relative motion. Kinetics of particles: Force, mass and acceleration; pendulum; work and energy; impulse and momentum; impact; steady and variable mass flow. Kinematics of rigid bodies: Combined sliding and rolling, Mechanism- slider crank, quick return, Link; 3-bar and 4-bar linkage. Kinetics of rigid bodies: Gyroscopic motion and precision.

<b>FS 121 Surveying</b>	<b>Credits- 2</b>
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Types and Instruments of surveying. Chain survey: Plotting details, Errors, Merits and demerits. Traverse survey: Procedures, Bearing measure and plotting, Errors and adjustment, Merits and demerits Plane Table survey: Orientation, Merits and demerits, Two and three point problems. Levelling: Objectives, Methods, Reduced level, Effects of curvature and refraction and their corrections. Contouring: Characteristics and uses, Direct and indirect methods. Cadastral survey: instruments, procedures and land settlement and map preparation. Curves: Types, Curve components, Setting of circular, transition and vertical curves, Super elevation and Shift. Project survey: Classification, Irrigation and Canal projects

<b>FS 122 Field Surveying</b>	<b>Credit-1</b>
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Chain survey: Location of stations, setting offsets and plotting. Land survey: segmentation and measurement of land area. Traversing: Measurement of bearings, setting stations, plotting and error correction. Plane tabling: Location of objects by radiation and intersection methods. Levelling: Measurement of land undulation and cut-fill measure. Contouring: Setting of contour lines and volume measure of depressed area. Curve ranging: Setting curves for roads and canals for minimal turning risks. Canal project: Setting canal alignment, measurements of reduce levels, plotting canal way. Irrigation project: Setting grids, measurement of elevations at grid corners, cut-fill volume.

<b>CSM 211 Mathematics-III</b>	<b>Credit- 3</b>
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Fourier series & Fourier integrals: Trigonometric series; the Euler-Fourier formula; expansion of functions into Fourier series; half range expansions; the Fourier integrals; Fourier series. Legendre polynomial: Legendre polynomial from Legendre equation; recurrence formula for Legendre polynomial, Rodrigues formula; Orthogonality of Legendre polynomial; generating function. Bessel's functions: Derivation of Bessel's function from the solution of Bessel's equation; recurrence formula for Bessels functions; orthogonal properties of Bessel's functions. Vector calculus: Scalar & vector functions; gradient of a scalar function; curl & divergence of a vector function; Green's theorem; Gauss's divergence theorem and Stokes theorem.

<b>CSM213 Computer Application</b>	<b>Credit- 2</b>
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Web page design using FrontPage ,HTML tools and its resources ,linking, style, and publishing. XML fundamentals ,XML parsers ,XML API. Java basics and networking using Java, Java classes, java script, Java's security. VB basics, VB script, Introduction to CGI programming, Perl interpreter, Perl Language, packages, modules and objects. Introduction to ASP, Application of ASP.

<b>CSM214 Computer Application</b>	<b>Credit- 1</b>
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Web page design using HTML, XML and FrontPage; JavaScript programming; Introduction to CGI and Perl language; ASP concepts; Network programming with Java.

<b>FTRI 211 Food Science</b>	<b>Credit- 2</b>
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Introduction to food science. Food and nutrition . Proteins, carbohydrates, fats, vitamins, minerals and water - sources, classification and functions. Chemical reactions: Oxidation, Nonenzymatic browning; Enzyme reactions. Microbial activity: Characteristics of microbes; effect of microbes on food. Food borne diseases: food infection and food intoxication and food poisoning. Principles and methods of food preservation: Use of low temperature; use of high temperature. chemical additives; irradiation of foods etc.

<b>FTRI 212 Food Science</b>	<b>Credit-1</b>
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Proximate analysis, Microbial load calculation, processing of fruits and vegetables for different products. Preparation of tin cans, seaming, double seaming etc.

<b>IWM 211 Fluid Mechanics</b>	<b>Credits- 2</b>
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General properties of fluid. Principles of hydrostatic pressure: Unit pressure, Resultant pressure, Pascal's Law, Free surface of a liquid, Atmospheric, absolute and gage pressure, Pressure head, Vapor pressure, Manometer, Micro-manometer, Piezometer. Buoyancy of fluid: Principle of Archimedes, Condition of equilibrium of floating bodies, Determination of metacentric height, Floating bodies, Flow of fluids, Path lines and stream tubes, Laminar and turbulent flow, Equation of continuity, Velocity head and total head of a fluid, Steady and unsteady flow and Uniform and non-uniform flow.

<b>IWM 212 Fluid Mechanics</b>	<b>Credit-1</b>
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Determination of location of center of pressure for a submerged plane surface. Determination of metacentric height of a floating body. Problems on fundamental properties of fluid. Problems on atmospheric, absolute and gage pressure. Problems on manometers. Problems on total pressure on plane surfaces. Problems on total pressure on curved surfaces. Problems on buoyancy.

<b>FPM 211 Thermodynamics</b>	<b>Credit- 2</b>
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Elementary thermodynamics of perfect gases, energy equations, laws of thermodynamics and their application, entropy and enthalpy, thermodynamic processes, gases and single phase system, steam and two phase system, steam plant, steam turbines, air compressors, ideal gas cycles, refrigeration, Calorimetry.

<b>FPM 212 Thermodynamics</b>	<b>Credit- 1</b>
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Problems on the application of the processes, laws, ideal cycles, use of steam and gas tables. Study on refrigeration system. Problems on entropy and enthalpy. Problems on air compressors, turbines.

<b>RS 211 Rural Sociology</b>	<b>Credit-2</b>
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Origin and Development of Rural Sociology; Scope, Importance Role of the Rural Sociologists in Agricultural Development. Methods and Techniques of Social Research: Scientific research methods, importance, value judgment and ethical issues, types, research process, sampling, mode of data collection and analysis of social data. Culture: Meaning, importance and function, elements, Cultural universals and variability, ethnocentrism and relativism. Rural Social Differentiation, Stratification and Rural Power Structure: Society, Technology and Rural Social Change. Rural social policy and planning and rural development.

<b>AEC 211 Agricultural Economics</b>	<b>Credit- 2</b>
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Scope of economics, basic concepts of economics and agricultural economics. Theory of consumer behaviour: Marshallian Utility analysis, Indifference curve analysis and elasticity of demand. Theory of Production: Factors of production, Law of diminishing returns. Stages of production, Optimum input use, Cost and revenue concepts, Markets and their characteristics, Price determination under different market conditions. Concepts and measurement of national income, Difficulties of measuring national income in Bangladesh, Role of agriculture in the economic development of Bangladesh, Problems of agricultural development in Bangladesh.

<b>HORT 211 Horticulture Science</b>	<b>Credit- 2</b>
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Definition, branches, importance and scope of horticulture. Propagation of horticulture crops: Advantages, disadvantages, method and techniques, construction of green house, lath house and mist house. Production technology of the following horticulture crops: Production statistics, soil, climate, varieties, propagation, cultural practices, pest management and harvesting of banana, papaya, pineapple, mango, jack-fruit, litchi, potato, tomato and cauliflower. Harvesting and post harvest handling of horticulture crops: Harvesting, curing, grading packing processing, shipment and marketing o horticulture produces.

<b>HORT 212 Horticulture Science</b>	<b>Credit-1</b>
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Lay out and designing of green house, lath house and mist house. Identification and use of nursery equipment's. Identification of horticulture crops. Preparation of seedbed and seedling raising. Methods of planting horticulture crops. Propagation practices of different horticulture crops.

<b>FPM 221 Electrical Engineering</b>	<b>Credit-2</b>
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DC Circuits- fundamentals of current, voltage, resistance and their units. Network Analysis: Methods of branch current and loop current. Superposition and Thevenin's theorems. Magnetic Circuits: magnetic flux lines, flux density, permeability and reluctance. AC Circuits: Instantaneous current, voltage and power. Cycles, period, frequency, phase difference and power factor. Phasor Algebra: Cartesian, exponential and polar forms of representation. Operators, addition, subtraction, multiplication and division. **Electronics** Atomic structure and energy bands in solids. Transport phenomenon in semiconductor, junction diode characteristics and diode circuits. P-n-p and n-p-n transistors circuits, signal power amplifiers, filtering. Integrated circuits: Feedback amplifier and Oscillators. Switching control and control circuits.

<b>FPM 222 Electrical Engineering</b>	<b>Credit-1</b>
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Elementary circuit and wiring. Use of voltmeter, ammeter and multi meter. Series and parallel circuits. Electric power distribution. Use of wattmeter and energy meter. Verification of superposition theorem. Verification of Thevenin's theorem. Study of RLC circuit. Half wave and full wave rectification. Small signal application. Design of control circuits. Study of applications in instrumentation.

<b>FPM 223 Heat Engines</b>	<b>Credit-2</b>
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Basic Engine types and their operation. Combustion and Fuels for ICE, knock and the engine variables. Fuel metering in SIE and CIE, IC Engine Characteristics and design, Major components and systems. Spark-Ignition and Compression Ignition Engines, Engine performance, exhaust gas analysis and air pollution.

<b>FPM 224 Heat Engines</b>	<b>Credit-1</b>
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General study on engines. Calculation of Ip and Bp and energy balance. Study on cooling, lubrication and Ignition systems. Two stroke, four stroke engine cycles and valve timing diagram. Study on injector, carburetor and fuel pump. Performance test of injector. Analysis of exhaust gas. Engine tuning.

<b>FS221 Strength of Materials</b>	<b>Credit-2</b>
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Elasticity, Deformation, Poisson's ratio, Mechanical properties, Stress-strain relationship. Stress: Stresses in cross-sections, Localised, Temperature, Shear and Combined stresses, Nature and causes of failure, Allowable and Working stresses. Shear force and Bending moment: Loading conditions, Sign convention, Shear force and Bending moment relations and diagrams for Uniform, Concentric and Inclined loading on horizontal and inclined beams, Thrust diagram. Deflection of Beam: Definition, Types, Methods, Deflections of cantilever and simple beam, Stress and Deflection of helical spring, Hoop-stresses. Torsion: Definition, Relation among curve, radius and moment, Torsion in circular and hollow shafts. Principal stress; column and strut.

<b>FS222 Strength of Materials</b>	<b>Credit-1</b>
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Reconnessences of material-testing laboratory and draw the layout, Hardness number of metallic plates. Shear modulus of a helical spring. Tensile strength of mild steel rods. Shearing strength of metallic wires. Deflection of wooden beam. Flexural strength of reinforced concrete slab and beam. Impact test by penetrometer.

<b>STAT 221 Statistics</b>	<b>Credit-2</b>
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Variables, Frequency distribution, Measures of location and variation and shape characteristics of curves. Random experiment:



outcome, sample space, events. Laws of probability. probability distribution. Probability function. Simple correlation and regression: Pearson's correlation coefficient, least squares method for fitting regression line. Population and sample, null and alternative hypotheses; Level of significance. Basic steps for testing hypothesis. Statistical tests: Significance of correlation and regression coefficients, independence of attributes. Statistical Quality Control.: Product control vs. process control, Problems and principles of statistical quality control. Construction of different types of control chart. Producer's risk and consumer's risk, OC and ASN functions. Experimental design: Basic concepts and principles.

<b>STAT 222 Statistics</b>	<b>Credit- 1</b>
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Frequency tables and their graphical representation. Measures of location and variation. Moments. Measures of skewness and kurtosis. Pearson's correlation coefficient. Fitting linear regression to observed data by the method of least squares. Statistical tests: A population mean is equal to a specified value, equality of two population means (for both independent & correlated samples), a population proportion is equal to a specified value, equality of two population proportions, independence of attributes, significance of correlation and regression coefficient. Analysis of variance for completely randomized and randomized block designs. Multiple comparison (using t and lsd). Construction of different types of control chart.

<b>FS223 Engineering Materials and Cost Estimation</b>	<b>Credit-2</b>
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*Materials:* Selection and use of engineering materials. .Bricks: Factors, Brick quality, Tests, Classification and Uses. Cement: Classification, Composition and Properties. Sand: Classification, Uses, Gradation and Fineness Modulus Concrete: Classification and Properties, Concrete mix design Timber: Wood structure and Volume measure, Characteristics and Seasoning. Steel: Classification, Composition and Properties Plastic: Composition, Properties and Uses of thermosetting and Thermophilic plastics. Painting materials: Composition, Types and Uses of enamel and Plastic paints, Varnishes, Ferrocement. *Cost Estimation:* Rates and Specifications. Earth work: Volume measure, Highways and Canals, Building work: Materials and Labour per Unit work, Brickwork estimation, Preparation of material and Cost sheets. Pipe, Drain and Canal: Material, Labour and Cost estimation of Sewer line, Surface drain and Canals Timber work: Material and Cost measure for King and Queen post roof trusses. Insulation work: Materials and measure of cost for floor, roof and wall insulation Work Scheduling: Preparation of schedule, Tender, Quotation and Indenting of materials

<b>FS 224 Engineering Materials and Cost Estimation</b>	<b>Credit-1</b>
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Water absorption and Crushing strength of brick, Unit weight and Fineness modulus of sand, Normal consistency and Setting times of Portland cement, Compressive and Tensile strength of cement mortar. Measurement of workability of Concrete mix, Compressive and Tensile strengths of concrete, Works, materials and cost estimation of a building.

<b>FTRI 221 Fundamentals of Food Engineering</b>	<b>Credit-2</b>
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Process and operations; kinetics of processed foods, fundamentals of mass transfer. Transportation: Cleaning, sorting, washing and size reduction, sieve analysis, mixing operations, blanching, cooking. Homogenization, Pasteurization and cooling-methods and equipment. Rheological behaviour of foods, properties of fluid foods, rheometers, friction in laminar flow and turbulent flow; power requirements of pumping fluid foods; properties of suspensions, concentrated products, granular foods, powders and solid foods. sanitary pumps and piping systems. Introduction to refrigeration and cooling systems for chilling foods. Heating systems including boilers for food processing plants. Steam as a heating source. Rating of boilers, boiler maintenance, fuel, boiler efficiency, steam purity, steam requirement and costs.

<b>FTRI222 Fundamentals of Food Engineering</b>	<b>Credit-1</b>
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Introduction to grinder, sieve and sieve shaker. Determination and designation of fineness of ground food. Design problems related to size reduction, cleaning, sorting, washing equipments. Spray drier, prepare milk powder. Functional system of a refrigerator, boiler, steam jacketed kettle, retort and exhauster-drawing and labeling of their functional parts and system. Chilling of fruits and vegetables at various low temperature and observation of effect on quality. Materials and heat balance. Problems and experiments on kinetics of reactions occurring in foods. Problems on pumping of fluid food, prevention of heat loss during heating and cooling.

<b>IWM 221 Hydraulics</b>	<b>Credit- 2</b>
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Euler's equation, Bernoulli's energy equation, Flow of gases. Flow through orifice, Coefficient of velocity, contraction and discharge, Head loss in orifice, orifice coefficients and their variations, Flow over notches and weirs: Fundamental theory, Standard weir formulas, Rectangular, triangular and trapezoidal weir, Flow over broad crested and submerged weir, Time of emptying reservoir. Flow through pipes: Critical velocities in pipes, Velocity head in a pipe, Loss of head in pipes, pipe diagrams, Flow in pipe networks. Introduction to open channels: Description, Uses, Velocity distribution, Wetted perimeters and hydraulic radius, Energy in open channel, Cross section of greatest efficiency.

<b>IWM 222 Hydraulics</b>	<b>Credit-1</b>
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Determination of coefficient of orifices. Determination of coefficient of notches and weirs. Determination of coefficient of venturimeter. Verification of Bernoulli's energy equation. Determination of coefficient of friction of pipe. Study of hydraulically operated control gates. Study of different types of flow. Problems on fundamentals of fluid flow. Problems on orifice, notch and weirs. Problems on pipes. Problems on open channels.

<b>FTRI 311 Unit Operations in Food Engineering</b>	<b>Credit-2</b>
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Physical, thermal and chemical properties of food products and handling materials. Harvesting and post harvest handling, grading, packaging, transporting and storage of fruits and vegetables. Heat exchangers and their classification. Design aspects of various heat exchangers. Quick freezing equipments and their classification, description, design and operation. Thawing equipments. Evaporation and concentration. Different evaporators, design principles of evaporator and their application in food processing. Drying process, water activities, moisture content, psychrometry. Dryers for various food materials. Operating principles and design aspects of different types of blanchers, filling machine, exhausters, double seamer and commercial retorts for canning of foods of different origin. Design of material handling equipments. Automatic control, automation and safety measures in food plant. Churning and butter handling equipment, cheese plant equipment. Irradiation, equipments for irradiation and related aspects.

<b>FTRI 312 Unit Operations in Food Engineering</b>	<b>Credit-1</b>
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Problems on determination of physical and thermal properties of food materials. Drawing & design problems on cabinet dryer, tunnel dryer, drum dryer, spray dryer, vacuum dryer and freeze dryer. Determination of dryer capacity as affected by process variables. Retort operation, design problems on retort. Design of blanchers, exhauster, double seamer and filling machine. Design of steam jacketed kettle. Problems on heat exchangers, freezing equipments and evaporator design. Design of material handling system and irradiation plant.

<b>BCHEM 311 Biochemistry</b>	<b>Credit- 2</b>
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Chemistry of carbohydrates. Browning reactions. Proteins: physical and chemical properties and determination of amino acids. Quality evaluation of plant and animal proteins. Lipids: Chemistry of fats, phospholipids and glycolipids. Fat with rancidity. Chemistry and function of steroids: Chemistry of nucleic acids. Structure and functions of DNA and RNAs. Chemistry of enzymes. Factors affecting enzymic activity. Role of enzymes in food industry. Vitamins and minerals: Classification, sources, biochemical functions and deficiency diseases: Concept of metabolism, different pathways. Metabolism of carbohydrate, fat and protein, and their interrelationship. Metabolic diseases and food therapy.

**BCHEM 312 Biochemistry                      Credit-1**

Preparations of buffer solutions and determination of pH. Colour test of carbohydrates and proteins. Preparation of starch and detection of amylase activity. Estimation of vitamin C. Proximate analysis: Moisture, fat, protein, crude fibre and ash. Estimation of protein by Kjeldahl and Biuret method. Determination of saponification and iodine value. Separation of sugars by TLC.

<b>VHM 315 General Microbiology</b>	<b>Credit-2</b>
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Importance of bacteria, molds, yeasts, algae and viruses in food science and technology as pathogen, nutrients and potential spoilage organisms. Morphology, cultural and biochemical characteristics of bacteria, molds, yeast, algae and viruses. Factors influencing growth and death of bacteria. Temperature and oxygen relationship of microorganisms. The mechanisms of bactericidal action. The taxonomy of microorganisms-nomenclature, genera, species and types. Pathogenic microorganisms and their relationship to disease; Mechanisms of infection; Microbial virulence; Factors influencing virulence; Koch's postulate. Basic concept of the immune state, Natural barrier; phagocytosis, antigens and antibodies toxin & anti-toxin and hypersensitive conditions.

<b>VHM 316 General Microbiology</b>	<b>Credit-1</b>
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The practical work of the students shall closely follow the theoretical lectures as far as practicable, and shall include the following: Sterilization, preparation of simple culture media, Microscopic examinations, staining procedures – Grams stain and Ziehl-Neelson's staining method. Cultivation of microorganisms, methods of obtaining pure culture. Use of sugar and other media in detection of unknown organisms. Students shall be required to show a good knowledge of the topics included in the theoretical portion of the paper. They shall maintain a record of everything done in practical classes in a laboratory notebook to be checked and signed by the teacher(s) concerned.

<b>FTRI 313 Food Packaging and Machinery</b>	<b>Credit-2</b>
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Food packaging; package functions and selection. Heat and mass transfer aspects. Food packaging machine parts, analysis of motion and displacement, velocity and acceleration of moving parts. Primary and secondary containers, degree of rigidity, pre-formed and in-line forming, hermetic closure. Materials of Packaging– paper and board materials, wood and textiles; flexible films, laminates, rigid and semi-rigid plastic, metal and glass. Package testing equipments and machineries. Filling Equipment: Types, functions and operation, principles of filling equipment Closing and Sealing Equipment: Principle, design, operation and handling of various closing and sealing equipments. Aseptic filling: Principle, design, operation and handling of Horizontal form-fill-seal machine, Horizontal form-fill-seal machine for sachets, a thermoforming filling and sealing system, tetra brick aseptic packaging system.

<b>FPM 313 Electrical Machinery</b>	<b>Credit-2</b>
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Transformers: Constructions, equivalent circuits, open circuit and short circuit tests. Three phase transformers & auto transformers. Rotating machines: Generated voltage and rotating magnetic fields, Introduction to DC and AC machines. DC machines: Armature reaction and commutation. Generator and motor analysis. Motor speed control and applications. Synchronous machines: Equivalent circuit, short circuit and open circuit characteristics and power angle characteristics, synchronous motors and V-curves. Induction motors: Equivalent circuit analysis, squirrel cage and wound rotor motors, and motor applications. Speed control. Fractional horsepower AC Motors: Single phase induction motors. Starting & running performances, universal & capacitor motors. Selection of motors.

<b>FPM 314 Electrical Machinery</b>	<b>Credit-1</b>
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Short circuit and open circuit tests of transformer. Experimental determination of voltage regulation and efficiency of a transformer. Construction of a three phase transformer using three single phase transformers. Building up of a shunt generator. Study of speed control of D.C. shunt motors. Study of three phase squirrel cage motor. Study of three phase wound rotor motor. No load & blocked rotor test of 3 phase induction motor. Study of single phase induction motor. Starting and operation of universal and capacitor motors.

<b>FS 315 Food Factory and Storage Building</b>	<b>Credit-2</b>
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Introduction: Food factories, types and purposes. Site Selection: Location, marketing utilities and facilities, soil investigation. Food Factory Building Components: Foundation, column, beam and roof elements. Environmental Consideration: Lighting, ventilation, sanitation and waste disposal. Floors and Walls: Selection of materials, aspects of strength and durability. Storage Buildings: Importance, types, climatic considerations and requirements

<b>FS 316 Food Factory and Storage Building</b>	<b>Credit-1</b>
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Principles of food factory and storage building design. Soil identification and test for soil moisture, soil densities and strength parameters. Design and layout of food factory and storage buildings. Visit to storage and food factories.

<b>CM 305 Accountancy</b>	<b>Credit-2</b>
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Fundamental concepts of Accountancy: Debit (Dr), Credit (Cr), Transaction, Business Transaction, Leger Posting, Accounting concepts and conversions. Double entry system of Accounting and Accounting Cycle: Accounts and its classifications. Cash Book, Classification of Assets and Liabilities, Financial Accounts with adjustments. Single Proprietorship business, Bill of Exchange. Application of accounting principles to food processing firms.

<b>FTRI 315 Renewable Energy in Food Processing</b>	<b>Credit-2</b>
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Introduction to solar, wind, hydropower, biomass and geothermal energy; Calculation of solar intensity; Design and description of solar collector, solar pond, solar cell, solar dryer and their use in food processing with particular reference to product quality and cost-benefit ratio.

<b>LAN 311 Technical Communications in English</b>	<b>Credit-2</b>
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Situational English (Oral & Professional): Selected dialogues and conversations each supplemented by socio-cultural rules necessary for effective language use. Reading Comprehension: Selected articles on science, agriculture and engineering. Writing skills: Practicing some compositional activities essential for making written communication; e.g. Letter (formal & informal), CV, Report writing, Precis, Summary, Paragraph, Abstract etc. Structural Grammar: Written: Sentence (Type and Structure), Agreement between Subject & Verb, Tense & Voice, Gerund, Participles, Infinitives, Model auxiliaries, Conditionals, Combination of Sentences. Phonetics (spoken): IPA. Pronunciation, Stress and accent, Intonation.

<b>FTRI 321 Food Chemistry</b>	<b>Credit-2</b>
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Composition of foods. Forms of water in foods; determination of moisture by different methods; Major source and types of carbohydrate. dietary fibre. Calorific values and digestibility of carbohydrates, sugar and polysaccharide in foods. Role and use of lipids in foods, processing fats and oils. Protein: Distribution, amounts and functions. Effect of processing on functional and nutritional properties of protein Vitamins and minerals: Requirements and allowances. Enrichment, restoration and fortification, Pigments in foods: Chlorophyll, carotenoids, anthocyanins and others, their properties and functions. Synthetic colours: structures, sources and properties .Flavour and aroma: Definition , importance to food processors, Flavours and flavourings in foods. The browning reactions: Enzymatic and nonenzymatic browning.

<b>FTRI 322 Food Chemistry</b>	<b>Credit-1</b>
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Evaluation of chemical leavening agent and their application in baked goods. Determination of relative sweetness of sugar. Characterization of sugar syrups- effect of temperature, concentration, agitation on solubility of sugar. Extraction, separation and characterization of food pigments. Determination of food additives, sodium benzoate, SO<sub>2</sub>, acidity and pH. Assessment of physico-chemical properties of major cereals.

<b>FTRI 323 Food Microbiology</b>	<b>Credit-2</b>
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Introduction to food microbiology, food as a substrate for microbes. Microorganisms important in food. Microbial contamination of food from natural sources and during handling and processing. General principles underlying microbial spoilage. Bacterial growth curve, thermal death time. Microorganisms important in the spoilage of different groups of food. Food poisoning and infection: Related organisms, outbreak, prevention and remedy, food sanitation, inspection and quality control. Fermentation, principle & manufacture of vinegar, citric acid, alcohol, beer etc. Manufacture of food yeast, production of food antibiotics, soyasauce, Koji, Miso etc.

<b>FTRI 324 Food Microbiology</b>	<b>Credit-1</b>
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Bacterial load calculation. Morphology of microorganisms. Water activity and bacterial growth, examination of cereals, meals, eggs, tomato, potato etc. for microorganisms. Effect of pH of substrate on heat resistance of bacterial spores, use of sodium benzoate, propionic acid, SO<sub>2</sub>, Sorbic acid, sodium chloride as preservatives. Spoilage of milk, meat, fish, egg, fruits and vegetables etc.

<b>Ag,Ext 321 Agricultural Extension Education</b>	<b>Credit-2</b>
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Meaning, Philosophy and principles of agricultural extension, need for extension work, tools, farm machinery, irrigation, food technology and farm housing. Personnel for extension work: administrators, supervisors, specialists and field extension workers; qualifications and responsibilities; Learning process: Laws of learning and their implications in extension work Communication in extension; extension teaching methods; classification of extension teaching methods. Technology transfer in agriculture: diffusion of innovation, factors affecting the diffusion of innovation, innovation-decision process and adopter categories. Programme planning process: Meaning of programme planning, principles and procedures of programme planning. Methods of problem identification in extension: PRA, PRA, FINA, ICAP Survey. Environment and sustainability issues of agricultural development: Impact of modern agriculture on environment.

<b>Ag,Ext 322 Agricultural Extension Education</b>	<b>Credit-1</b>
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Methods of data collection and preparation of interview schedule related to agricultural engineering works. Preparation of plan of work and calendar of work. Preparation of selected teaching materials such as poster, leaflet, flashcards and then presentation through lecture. Field trip in rural areas with farmers in order to be acquainted with the on-going and development activities at Upazela/Block/Village levels. Identification of problems and prospects of agricultural engineering works. Students would be required to visit different on going activities of GOs and NGOs, observe the existing equipment/machinery that are being used at different stages of farming including post harvest operations and submit a report at the end of the trip.

<b>FPM 327 Refrigeration and Air Conditioning Engineering</b>	<b>Credit-2</b>
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Applications of Refrigeration and Air Conditioning: Buildings, Industry, Vehicles, Food storage and distribution, food processing, special applications. Psychrometry and Wetted Surface Heat transfer:; psychrometric processes – humidification, dehumidification, adiabatic saturation, relative humidity, enthalpy, specific volume, heat and mass transfer. Advanced Psychrometry. Refrigeration: Reversed carnot cycle; Gas cycle refrigeration; simple vapour-compression refrigeration; absorption refrigeration; properties of refrigerants; Equipments – Compressors, condensers, evaporators, expansion devices and their controls; trouble shooting; multi-stage compression; cascade system; heat pumps. Cooling and Heating Load Estimation; Air conditioning Systems and Applications; Acoustics and Noise Control Cold Storage and Preservation

Chambers: Heat load estimation, design and selection of machinery.

<b>FPM 328 Refrigeration and Air Conditioning Engineering</b>	<b>Credit-1</b>
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Practice on problem solving on heat transfer, psychrometry; refrigeration building survey; occupancy, storage and heat load estimation; equipment selection and control measures. Visit to cold storage and food process industry.

<b>FPM 325 Heat and Mass Transfer</b>	<b>Credit-2</b>
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Modes of heat transfer, Fourier law of heat conduction, Newton's law of cooling for convection and thermal radiation. One dimensional steady state heat conduction. Two dimensional steady state conduction-numerical method of analysis, heat transfer from finned surfaces. Forced convection-boundary layer principles, Reynolds analogy and dimensional analysis. Natural convection – dimensional analysis of natural convection and formulae for prediction of natural convection. Types of heat exchangers, heat exchanger performance and heat exchanger transfer unit, Fouling and scaling. Radiation Heat Transfer: Physical mechanism and radiation properties, the radiation shape factor and relation between shape factors. Radiation exchange between black surfaces. Grey-body radiation exchanges and solar radiation. Mass Transfer: Fick's law of diffusion, mass transfer by molecular diffusion and convection, simultaneous heat and mass transfer phenomena, Empirical equations.

<b>FPM 331 Mechanical Design of Process Equipment</b>	<b>Credit-2</b>
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Philosophy of Design reliability Engineering. Materials for machine members. Design of machine members under simple combined stresses and variable loads including stress concentration. Flexible power transmission systems; Flat belt, V-belt. Pressure vessels: Thin cylinder with internal and external pressure. Thick cylinder; Selection of Cylinder Equation Compound cylinder. Cylinder heads and cover plates, flange joints. Design of process equipment, Evaporator and Condenser.

<b>FPM 332 Mechanical Design of Process Equipment</b>	<b>Credit-1</b>
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Design calculation for machine member of process equipment, short and long tube with internal and external pressure for thin and thick cylinder. Selection of Heads, cover plates and belts.

<b>FTRI 325 Tea, Coffee, Cocoa, and Spices Technology</b>	<b>Credit-2</b>
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Tea: Brief description of tea plant; composition of tea; chief characteristics of different types of tea; processing of tea – withering, rolling, fermentation, frying etc; manufacturing of green tea and instant teas; quality control and packaging of teas. Coffee: Structure of coffee beans; processing of coffee- roasting, grinding, blending, quality control and packaging.; soluble (instant) coffee; processing of instant coffee. Cocoa: Structure of cacao-seeds; beans selection; processing of cocoa products – cocoa butter, chocolate and its products; quality control and packaging of cocoa products. Spices: Classification of spices; chemical composition and flavouring components of spices; manufacture of essential oils and oleoresins; processing, preservation, quality control, packaging and storage of various spices and their products.

<b>FTRI 327 Food Machinery Manufacture and Maintenance</b>	<b>Credit-2</b>
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Introduction to materials of construction of food machineries. Description, production and manufacturing processes of food machineries; machining accuracy, surface quality, allowance and tolerance in manufacturing; production planning, metallurgy; balancing of work pieces and assembly; repair and maintenance.

<b>FTRI 329 Waste Treatment and Utilization in Food Industry</b>	<b>Credit-2</b>
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Typical wastes; character of wastes; Fruit by-products– pineapple waste, Fruit peels and cores, waste from grape, jack fruit, mango, pineapple– juice factories and Hineries, Almond Hulls, Raisin seeds and stems, by-products in cereal industries; waste juice and syrup from canning; olive wastes; Utilization of vegetable waste. waste treatment processes, physical, chemical and biological– Aerobic and anaerobic; stages of digestion, waste water treatment– primary treatment, secondary treatment– Trickling filters, Activated sludge tanks, ponds and lagoons, solid waste, upgrading and treatment. Ultimate sludge disposal– dumping, incineration and composting; future of waste treatment.

<b>FS 321 Environmental Engineering</b>	<b>Credit-2</b>
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'The environment' – its components, human-environment interaction, The spheres: Atmosphere; its layers, composition, quality, hydrosphere, the hydrologic cycle, water, supply-sources, treatment, distribution, water quality-criteria, standard, control, waste water-collection characteristics, its microbiology. Pollution and control: Air, soil, water & noise pollution – causes, effects, control. Special problems of concern: Green house effect, ozone layer depletion, photochemical smog, acid rain, radioactive pollution, arsenic pollution. Environmental laws and legislation: International and Bangladesh laws, their enforcement.

<b>FTRI 331 Biochemical Engineering</b>	<b>Credit-2</b>
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Biological materials including mutation and gene cloning. Micro organisms: energy yielding compounds, systems, accumulation of metabolites, Kinetics: enzyme systems, absolute reaction rate theory, kinetic patterns of various fermentations. steady state continuous cultivation theory, microbial dynamics in chemostat culture, batch and continuous cultivation with examples. Aeration and agitation: mass transfer and microbial respiration, bubble aeration and mechanical agitation, factors influencing oxygen transfer coefficients. Media sterilization: batch and continuous, air sterilization, design example of a filter for air sterilization, PVA filter for air sterilization. Equipment design and asepsis: fermenter design, cardinal rules, materials of construction and vessel size, bearing assemblies, motor drive, aseptic seals, aseptic operation, tangential flow filtration (TFF), piping and valves for biochemical engineering, pressure relief, cleaning and sterilization of process equipment

<b>FTRI 333 Report and Proposal Writing</b>	<b>Credit-2</b>
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Reporting, Technical information and Proposal. Project report, Thesis, Progress report, and Feasibility report. Basic elements of a report- abstract, introduction, title, literature & review, methodology, results & discussion and summary & recommendation, *Mechanical elements*: covers, title pages, table of contents, list of illustrations, glossary & list of symbols, captions, numbering systems, documentation, notes & footnotes, bibliographies & reference list, copyright, pagination, appendices & annexure, *Graphical elements*: tables, graphs, drawing, diagrams & photographs. Presenting data in a technical report- Types, tabular & graphical presentation, example. Writing a research proposal- Project planning, designing proposals, work plan, basic elements of a proposal, examples of proposal used by some well-established organization and proposal offering.

Writing notice, quotation and tender.

<b>FTRI 335 Food Irradiation</b>	<b>Credit-2</b>
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Major types of food irradiations: ionizing radiation, ultraviolet (UV) radiation and microwave heating. Major types ionizing radiations : X-rays, Gamma rays, Beta rays and cathode rays. Units and dose of ionizing radiations. Effects of ionizing radiations on microorganisms, enzymes, insects and food components. Application of ionizing radiations in combination with other methods of food preservation ; ionizing radiation treatment of water, sewage and food processing wastes. UV radiations: Source and mechanism of UV radiation; UV food applications; factors influencing UV radiations. Microwave processing; Packaging of radiation stabilized foods. Effects of radiation processing on the packaging materials. Safety and wholesomeness of irradiated foods; Food irradiation in Bangladesh: prospects and problems.

<b>CSM 405 Electronics and Instrumentation</b>	<b>Credit-2</b>
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Semiconductor diode operation and characteristics; transistor operation, characteristics and equivalent circuit; self-biasing circuit; amplifiers; transistors and its applications; time circuits; DC motor speed control circuit; types of application of measurement instrumentation; generalized configuration and functional descriptions of measuring instruments; performance characteristics of instruments; static and dynamic characteristics; measuring devices; measurement of voltage, current, power, energy, flux and light; AVO meter, Oscilloscope; transducers; strain, temperature and pressure measurement; accuracy and error measurement. 15 hrs lab. practices

<b>CSM 406 Electronics and Instrumentation</b>	<b>Credit-1</b>
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Practical classes based on CSM 405 course; assignment and project work

<b>FTRI 401 Food Analysis and Nutrient Technology</b>	<b>Credit-2</b>
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Physico-chemical methods used in food analysis: density and specific gravity, refractometry, polarimetry and saccharimetry, chromatography, ion-exchange, hydrogen ion concentration, polarography, nuclear magnetic resonance, conductivity, viscosity. Food groups and their constituents in relation to nutrients and energy content. Essential nutrients of food. Recommended dietary allowance. Energy value of different foods. Factors effecting nutrient loss from various foods. Reaction rate and optimization technique. Effect of handling and processing on changes in nutrient content in fresh, stored & processed product. Recommended diets and dietary allowances. Fortification and engineered food.

<b>FTRI 402 Food Analysis and Nutrient Technology</b>	<b>Credit-2</b>
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Orientation on food processing and analytical equipments. Proximate analysis of foods of plant and animal origin. Determination of vitamins and minerals. Formulation and processing of classified food products for different age group. Enrichment and fortification of foods.

<b>CM 417 Agribusiness and Marketing</b>	<b>Credit-2</b>
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Agribusiness : definition, scope and importance. Agribusiness system and goals of agribusiness firm. Managing the agribusiness: Business location, business facilities, production, services or sales activities. Marketing concepts and development of marketing plan. Analysis of market. Marketing mix decisions: The product, the price, the place and the promotion. Food processing & manufacturing industries in Bangladesh & their marketing problems.

<b>FTRI 403 Post Harvest Technology of Agricultural Produce-1</b>	<b>Credit-2</b>
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Composition of major and minor field crops. Post harvest handling and storage of field crops. Rice Technology: Parboiling, drying and milling paddy. Processing and cooking; enrichment of rice with vitamins and minerals, by-products of rice milling industry and their utilization. Milling of wheat; flour treatment for diversified uses, by-products of flour milling and their utilization. Principles of baking. Processing and utilization of maize, barley, oats, sorghum rye and millets. Manufacture of starch. Processing of pulses/legumes in to value added products. Tuber crops: Postharvest handling and storage of various tuber crops such as potatoes, sweet potatoes, cassava etc. Manufacture of potato chips, French –fries. Principles, design, operation and handling of specialized machineries. Processing of tuber crops for value-added products. Sugar technology: Manufacturing process sugar from sugar-cane, sugar beet etc. Design, operation and maintenance of related equipment.

<b>FTRI 405 Food Plant Design, Layout and Management</b>	<b>Credit-2</b>
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Hygienic design of food plant– site selection, planning the building on the site. Criteria of a good plant layout. plant layout for different products, such as fish canning plant, milk, cheese , yogurt and ice cream plant, drying plant, poultry and meat processing plant, egg processing plant etc. Hygienic design of various component of food plant such as foundation, supporting structure, walls, floors, floor drains, insulation, doors, piping etc. Water supply, water quality and treatment.. Waste disposal and sanitation in food plant. Cleaning and sterilizing of food plant, equipment and supply systems. Company and its classification. Organization structure, authority, personnel management. Employee welfare and labaoour laws. Planning, scheduling and control. Productivity and profitability, cost analysis. Good manufacturing practices. Food service systems technology: Description of various systems and their management aspects.

<b>FTRI 410 Project Work and Seminar</b>	<b>Credit-1</b>
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The students are required to undertake project individually or in a group under the supervision of a teacher of the Dept of Food Technology & Rural Industries. The students shall present seminars on the topic selected for the project. The course will include literature survey and plan of work for the research to be undertaken in level-4, Semester-2 in the field of food engineering and/or food technology.

<b>FTRI 406 Food Technology -1</b>	<b>Credit-1</b>
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Analysis and evaluation of wheat flour, preparation and composition analysis of gluten. Formulation and manufacture of various baked products e.g. Breads, Cakes, Biscuits etc. Preparation of composite flour (wheat flour, rice flour, cassava flour etc.) Manufacture of baked products from composite flour. Formation and preparation of various still and carbonated beverages with or without fruit juice. Laboratory exercises/ Assignments on composition analysis and processing of tea, coffee and cocoa. Processing and preservation of various spices e.g. Drying, powdering, paste etc. Production and analysis of fermented food products: Beer, wine, distilled spirits, vinegar, dahi /yogurt etc.

<b>FTRI 407 Beverage and Fermentation Technology</b>	<b>Credit-2</b>
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Introduction to soft drinks, beverages and fermented products and their classification. Methods of preparation , rocessing, preservation, handling and storage of soft drinks and fermented products.Ingredients and manufacture of non-carbonated and carbonated soft drinks– sugar, flavourings, colour, acids, water, carbon-di-oxide. Fruits and vegetable juices, pulps, squash, cordials, nectars, purees, sauces etc. Food fermentation- Introduction, definitions, additional benefits from fermentation, types of microbial changes in food; controlling fermentations in various foods; alcohol – use of starters, temperature, level of oxygen, salt etc. Preparation of beer, wine and fermented milk products– manufacture of cheese, butter, yogurt etc. Continuous cultivation and fermenter design.

<b>FTRI 409 Baking and Confectionery Technology</b>	<b>Credit-2</b>
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Wheat flour milling: The milling process; products and by-products of flour milling industry. Quality control and flour testing; Tests for baking quality of wheat flour. Yeast-leavened products: Flour quality for bread making; Bread making – standard formulation of bread, manufacturing process of bread and associated machineries; Defects in breads and their prevention. Soft wheat products: soft wheat vs. hard wheat flour, chemical leavening agents; Formulation and manufacturing process of biscuits, cakes, crackers, and other soft wheat products and associated machineries - ovens, mixing machine etc. Functions of various raw materials used in baking industries. Rice flour for baking: problems of baking, production of bread, cakes and

biscuits/cookies; composite flour in baked products. Pasta and Noodles: Flour for pasta and noodles; Production processes and associated equipments. Breakfast cereals: Classification and manufacturing process. Confectionery Products: Types of confectionery products. & manufacturing processes. Good Manufacturing Practices(GMP) in baking & confectionery industries.

<b>FTRI 411 Dairy Engineering</b>	<b>Credit-2</b>
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Mass and energy balance in dairy industry. Dairy plant design and layout. Metals used in dairy equipment. Application of mechanical separation in dairy product industry, design of centrifuge equipments especially milk fat centrifuge, ultra filtration and homogenizer. Design of thermal processes for pasteurization and sterilization; process design and equipment for butter, cheese, ice-cream, yogurt, condensed milk and powder milk.

<b>FTRI 413 Safety and Sanitation in Food Industry</b>	<b>Credit-2</b>
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Implication of current Good Manufacturing Practices and food plant sanitation. The regulation for current good manufacturing practices. Planning of plant sanitation programme and construction factors. Hygienic design of food plants and equipments. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Water and food plant sanitation. Cleaning and disinfection: A chemical and microbiological approach. Cleaning the food plants. Employees and food plant sanitation. Food safety and hazard analysis. Plant inspection and critical control point inspection. Role of quality assurance in food plant sanitation.

<b>FTRI 415 Handling and Storage of Horticultural Crops</b>	<b>Credit-2</b>
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Introduction to handling and storage of horticultural crops. Definition of fruit and vegetables. Structure and composition of fruit and vegetables: cellular components, chemical composition and nutritive value. Physiology and biochemistry of horticultural crops: physiological development, fruit ripening, biochemistry of respiration. Changes during maturation. Effect of temperature, water loss and humidity on the quality of horticultural produce. Physiological disorders of horticultural crops. Quality evaluation of horticultural crops: Quality standards, Quality criteria, Postharvest factors influencing quality, determination of maturity. Commodity treatments: Controlled ripening, control degreening, control of superficial scald, calcium application, waxing & irradiation. Packaging and technology of storage of horticultural crops: Modern packaging of fresh produce; methods of storage of fresh horticultural crops.

<b>FTRI 416 Food Technology –II</b>	<b>Credit-1</b>
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Determination of composition and quality of fresh fruits and vegetables. Pre-packaging, packaging and storage of fresh fruits and vegetables at room temperature and refrigerated condition. Material and energy balance in dairy industry. Design of dairy equipment: Pasteurizer, Homogenizer, Chilling equipment, Evaporators etc. Cost estimate of dairy plants. Processing of market milk, butter, yogurt, ice-cream, cheese and condensed milk and their composition. Identification of natural fats and oils. Determination of physical and chemical properties. Tests for rancidity: Preparation of margarine, butter and other fat products. Planning of plant sanitation programme and construction factors. Current Good Manufacturing Practices .

<b>FTRI 417 Technology of Fats and Oils</b>	<b>Credit-2</b>
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Sources of fats and oils, functional properties of fats; Production and processing methods of fats and oils – rendering, expeller pressing and solvent extraction. Refining of fats/oils– steam refining, alkali refining, bleaching, steam deodourisation; Hydrogenation, winterizing; Monoglyceride and diglyceride preparation; Identifications of fats and oils. Technology of Individual Fat products– Butter, oleoil and oleosterim; Lard– Intersterification in lard. Salad, cooking and frying oils, shortenings, margarine; The shortening value of different fats; importance in diet.

<b>AS 413 Animal Science</b>	<b>Credit-2</b>
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Introduction to animal and poultry production. Nutritional value of meat and meat products and their physico-chemical composition. Slaughtering of animal and poultry. Post-mortem changes. Evisceration and dressing of whole poultry for marketing fresh/chilled; changes of microflora, contamination and hygienic handling. Egg production, grading, candling and handling of egg. Beef retail cuts, palatability characteristics. Preservation of meat and quality factors in judging fresh and processed meat. Changes of microflora, contamination and hygienic handling.

<b>AS 414 Animal Science</b>	<b>Credit-1</b>
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Visit and demonstration at BAU farms, slaughtering of animal and poultry, demonstration of post-mortem changes. Beef, mutton retail cuts. Evisceration and dressing of poultry. Egg grading, candling and handling of egg. Freshness test of meat, poultry and eggs.



<b>DS 415 Dairy Science</b>	<b>Credit-2</b>
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Introduction to milk production. Milk composition, physical, chemical and nutritional proportion of milk. Sources of contamination of milk and their control. Milk borne diseases. Hygienic handling and transportation of milk from farm/factory and grading, mixing of fresh milk, processing and quality control of market. Hygienic operation in a market milk plant. Fresh and sour cream and related products, processing of butter, ice cream, cheese condensed milk and yoghurt.

<b>DS 416 Dairy Science</b>	<b>Credit-1</b>
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Physical, chemical and microbiological test of whole, skim milk and butter milk. Detection of adulteration of milk. Test for quality: Sediment test, acidity test, methylene blue reduction test and determination of pH of milk. Laboratory pasteurization and homogenization of milk production cream, butter, cheese in the laboratory.

<b>FT 413 Fish Processing</b>	<b>Credit-2</b>
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Introduction to fish processing. General principles of fin fish and shell fish preservation and storage. Post mortem changes in fish. Low temperature preservation of fish and quality control. Fish curing: drying, dehydration, salting and smoking methods and quality aspect. Fish canning and quality of canned products. Modern approaches to fish processing including vacuum packaging, irradiation in packaging etc. Packaging – function, selection, regulation etc. Planning and design of cold storage and fish processing plant.

<b>FT 414 Fish Processing</b>	<b>Credit-1</b>
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Acquaintance with fish processing laboratories. Study of proximate composition of fish – (Moisture, Lipid, Ash and Crude protein). Determination of non-protein nitrogen (NPN) of fish. Determination of salt (NaCl) content in salted fish. Freshness test of fish by subjective method. Processing and preservation of fish by sun drying, salting and smoking method and observation on their physical and chemical changes.

<b>FPM 415 Agricultural Machinery</b>	<b>Credit-2</b>
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Introduction to agricultural machines and implements. Machine performance: field capacities and efficiencies, factors affecting capacities and efficiencies. Mechanics of tillage: soil failure mechanism, tillage tool design factors forces, drafts and drawbar pull. Soil tillage: tillage implements and their operations. Hitching of implements, load transfer and balancing of prime movers. Crop planting and Fertilizer application machines: their types, metering devices, factors affecting operations and calibration. Spraying and Dusting machines: types, types of atomization devices and factors affecting operation and performance. Crop harvesting, threshing and chipping machines: their operation, performance and adjustments; losses, adjustments and calibration.

<b>FPM 416 Agricultural Machinery</b>	<b>Credit-1</b>
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Study of primary and secondary tillage implements. Hitching of tillage implements and machines. Field operation of primary and secondary tillage implements. Measurement of draft, specific draft, drawbar powers, slips and field capacity of primary and secondary tillage implements. Study of seed drills, fertilizer distributor, sprayers, reapers, combine harvester and threshers. Calibration of seed drills, fertilizer distributor, and sprayer. Field operation of reaper and combine harvester. Determination of capacity, losses and material efficiency of a thresher.

<b>FPM 417 Rural Electrification Engineering</b>	<b>Credit-2</b>
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Rural electrification in Bangladesh: Pally Bidyut Samity (PBS) and socioeconomic impacts of rural electrification. Supply systems: Transmission and distribution systems. Poly phase systems. Delta-Wye connected systems. Balanced and unbalanced loads. Comparison of conductor costs: Overhead and cable systems. Economic size of conductor. Kelvin's Law. Mechanical design of overhead lines: Line supports and sag calculation. Overhead insulators: Types of insulators, potential distribution over a string of suspension insulators and methods of increasing potential. Electrical design of overhead lines: Line constants, short and medium length line calculations. Farmstead distribution system: Load centers, service entrance switch capacity and selection of wire sizes, earthing methods. Voltage control: Tap changing transformer, automatic voltage regulator. Symmetrical components: Symmetrical components of unsymmetrical phasors. Unsymmetrical faults. Line to ground fault, line to line and double line to ground fault. Circuit breakers: Introduction to circuit breakers and its function. Different types of circuit breakers. Protective relaying: General requirements and logical design of relays. Over current relays, directional relays, impedance relays and differential relays. Protection of lines and transformers: Oil circuit reclosure & lighting arrester.

<b>FPM 418 Rural Electrification Engineering</b>	<b>Credit-1</b>
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Electric wiring practices: Wiring code, procedures and safety rules. Design of outlets, branch circuits and service entrance

switch for residences, farms, office and factory buildings. Locating load center and finding wire sizes for feeder lines. Design of rural distribution systems. Electrical design of overhead lines. Mechanical design of overhead lines. Study of circuit breakers. Study of automatic circuit reclosure. Study of lighting arresters. A field visit to a PDB substation and a report on field trip. A study tour to REB substation and electrified farms.

<b>CSM 402 Computer Aided Design</b>	<b>Credit-1</b>
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Basics of AutoCAD; drawing lines, circles, arcs, ellipses, polygons, drawing filled objects and solids; changing view of the drawing creating and deleting views; managing drawing layers; precision drafting tools; editing drawing; placing text on a drawing; drawing patterns and section lines; dimensioning a drawing; multi-view drawing layout, plotting and plot styles; 3D drafting; file management and data exchange; use of Auto LISP for programming.

<b>FTRI 421 Food Process Engineering</b>	<b>Credit-2</b>
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Theory of thin layer drying and deep bed drying of food. Quality aspects as affected by drying parameters. Theory of vacuum drying and freeze drying process and related quality aspects. Drum drying and spray drying process, and Instantizing of fruit juice and milk powder. Equipment design, operation and maintenance. Design of freezing process, its application on food freezing and related quality aspects. Design of canning process and developing canned products. Egg processing, poultry and meat processing and packaging, manufacture of ice cream, cream and condensed milk; description, operation and maintenance of associated machineries. Design of contact equilibrium process such as absorption, extraction, and distillation. Design of mechanical separation process such as filtration, sedimentation, centrifugation; description, operation and maintenance of associated machineries. Scale-up of food process.

<b>FTRI 422 Food Process Engineering</b>	<b>Credit-1</b>
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Experiments on thin layer drying of food materials of plant, animal, fish and shell-fish origin to determine effects of process parameters on rate constants and to evaluate activation energy for diffusion of water. Problems on design aspects of deep bed drying and dryers. Effects of drying parameters on retention of nutrients and enzymatic and non-enzymatic browning in food materials. Problems on design aspects of vacuum, freeze, spray and drum drying process. Experiments to develop powder from fruit juice, milk and egg. Experiments on poultry, meat and egg preservation by freezing and canning, manufacture of ice cream, cream and condensed milk, problems on design of related machineries. Problems on contact equilibrium process and mechanical separation process.

<b>FPM 421 Engineering Management</b>	<b>Credit-2</b>
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Basic concepts: Meaning of management; elements of management; function of a good manager; organization for management; company organization structure; process of delegation; responsibility and authority. SWOT (Organizational strength, weakness, opportunity and threat) analysis. Economic and financial analysis: net present value, internal rate of return, pay back period, cost-benefit ratio; economic comparison between investment alternatives. Linear programming – Formulation of LP models; graphical solution, simplex method, duality theory and sensitivity analysis. Network analysis – Shortest-route problems, minimal spanning tree problems, maximal flow, PERT and CPM. Transportation and distribution problem – formulation and solution of transportation and assignment problem. Introduction to inventory model and queuing theory. Introduction to Dynamic Programming. Purchasing Function – Methods of purchase, interactions between supplier/contractor and the purchasing department; introduction to accounting procedure; Tender and quotation; signing of contract. Project Planning Cycle – Introduction to Participatory Planning and need assessment (PRA & PNA); Problem tree; stakeholder analysis; logical frame and activity bar chart.

<b>FTRI 423 Quality Control in Food Industry</b>	<b>Credit-2</b>
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Introduction: Quality of foods, quality factors and principles and methods for determination of various quality factors under appearance, kinesthetic and flavour properties. Effects of various cultural practices on quality of foods. Quality standards: Quality control: Modern and total quality control: Subjective and objective methods for determination of quality of foods. Factors affecting quality of food products. Food products development: Sensory evaluation of foods: Various methods, their description and implications. Application of sensory tests to food industry problems. Instrumental and microbial methods of quality control and assurance. Hazard Analysis and Critical Control Points (HACCP). Food regulation and compliance. Food adulteration and misbranding. Products specifications. National and international food standards.

<b>FTRI 424 Quality Control in Food Industry</b>	<b>Credit-1</b>
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Identification of sensory attributes of different foods and food products. Sensory evaluation of foods; Physical, chemical and microbiological methods of foods as applied to food quality control. Co-relations among the different methods used for the quality control of foods.

<b>FTRI 425 Post Harvest Technology of Agricultural Produce-II</b>	<b>Credit-2</b>
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Introduction to horticultural crops of Bangladesh. Structure and composition of fruits, vegetables, spices and tea, coffee, cocoa. Principles and methods of preservation of these crops. Harvesting, cleaning, sorting, grading, handling, pre-packaging, transportation and distribution of fresh fruits and vegetables. Commodity treatment, thermal and chemical treatment, radiation etc. and processing for canning, semi-solid food, bottling, pickling of fruits and vegetables. Processing of tea, coffee, cocoa and spices. Effect of process parameters on quality of end products. Physiology and biochemistry of fruits and vegetables. Effects of temperature, water loss, humidity, storage atmosphere on fruits and vegetables. Physiological and physical disorder, quality evaluation, storage and packaging technology of fruits and vegetables. Low temperature and high temperature storage. Postharvest handling, freezing, canning, drying of fish and shell-fish.

<b>FTRI 426 Post Harvest Technology</b>	<b>Credit-1</b>
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Laboratory exercises/Assignments on pre-packaging of fresh fruits and vegetables; physico-chemical properties of fruits and vegetables affected by time, temperature, pressure, light and packaging patterns. Preservation of fruits and vegetables as sugar concentrate products, manufacture of fruit and vegetable drinks, pickles, sauces and chutneys. Effects of process parameters on quality of the above-mentioned end products. Demonstration on parboiling, drying and milling of paddy. Formulation and manufacture of baked products. Manufacture of starch, processing of potato chips, French-fries etc.

<b>FTRI 427 Engineering Properties of Food Materials</b>	<b>Credit-2</b>
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Principles of shape and size 'density' determination; rheological properties of liquid food materials and non-Newtonian fluids; Properties of suspensions and concentrated food products, granular foods powders and solid foods, relationship of visco-elastic properties of solid food and food texture. Methods of determination of thermal properties of food materials including examples of empirical solutions, thermal properties of porous and rigid food materials; Freezing and freezing time of water content in food materials, electrical and light properties of food materials; Analysis and utilization of data related to engineering properties for designing of storage, handling and processing of food materials. Mass transfer properties of foods.

<b>FTRI 428 Training in Food Industry</b>	<b>Credit-1</b>
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The students undertake practical training in different food industries for a period of 45 days in food processing, preservation, quality control, operation and maintenance of food machineries and management aspects of the concerned food industries. The students are required to submit reports after completion of the training in the food industries based on the above mentioned areas.

<b>FTRI 430 Project Work &amp; Report</b>	<b>Credit-3</b>
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The students are required to undertake project individually or in a group under the supervision of a teacher of the Dept of Food Technology & Rural Industries. The project shall involve a literature survey, an experimental investigation, and the final preparation of a detailed report on a selected topic in food engineering and/or food technology.

<b>FTRI 431 Sugar Engineering</b>	<b>Credit-2</b>
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Introduction to sugarcane, sugar beet and sugar processing Industry, Factory site for sugarcane industry. Sugarcane protection. Composition of sugarcane and sugar beet. Effect of variety and environmental conditions on sugar content. Properties of sucrose, saccharose and reducing sugar. Milling, pH control. Methods of clarification. Filtration: procedures and methods. Evaporation. Incrustation, formation and removal. Sugar boiling, Centrifugal separation, Crystallization, Masecutes, Molasses, Magma etc., Curing and finishing. Sugar conveyor, drying and storage. Deterioration of sugar. Microorganisms in sugar manufacturing. By-products of sugar industry.

<b>FTRI 432 Sugar Engineering</b>	<b>Credit-1</b>
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Determination of reducing sugars, dry substance in raw and refine sugar and in molasses, Determination of inorganic constituents in sugar, molasses and masecutes. Determination Pol (sucrose), extraction%, purity conductance, crystal content, deterioration factor, dilution, fibre, fibre-solid ratio recovery etc. of bagasse, cane and juice. Preparation of solution for chemical and biochemical analysis, normal molar, molal solution, percent, ppm, and standard solution. Preparation of some traditional sugar and jaggary products.

<b>FTRI 433 Food Engineering Systems</b>	<b>Credit-3</b>
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An Introduction to Systems Engineering; Systems Engineering Processes and Life Cycles; Systems Management; Information Requirements, Risk Management, and Associated Systems Engineering Methods; Applications of Linear Programming and

graphical solutions of food engineering problems; Integer Programming: An application of computer programming to solve engineering problems; Production Control; Inventory Control and Budgeting; Transportation Optimization; Research and Development Management; Break-Even Analysis. A case study in knowledge engineering.

<b>CSM 437 GIS and ICT</b>	<b>Credit- 2</b>
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Fundamentals of GIS, GPS and ICT and their applications in Agriculture; GIS mapping and analysis software; GIS dictionary; Free GIS data depot; GPS data resource;GPS working; scope & application of ICT in GIS & GPS.

<b>CSM 438 GIS and ICT</b>	<b>Credit-1</b>
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Terminal use based on the Course CSM 437; Class assignments and project work.

<b>Ag.EXT 429 Extension Communication Management</b>	<b>Credit-3</b>
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Introduction: Concept of communication, need and importance of communication for agricultural development. Basic Communication Process: Steps in basic communication process intended message, encoding, transmission, reception, decoding and understanding, feedback in communication, distortion in the communication process, written communication, verbal communication, non-verbal communication, noise and barriers to written and verbal communication. Communication Networks and Patterns: Common communication networks-chain. Y wheel, circle, star and com-con: downward, upward, horizontal, one-way, patterns of communication. Communication Models and Elements: Lasswell, Shamon and Weaver, Barlo models of communication, source, message, channel, treatment of message, audience, audience response, characteristics/qualities of the key elements in the communication process noise in the communication process. Communication in Groups: Facilitation, increasing participation on the participants in the group communication qualities of a communication in the group communication handling trouble-makers in group communication