B. E.

in

FOOD TECHNOLOGY

(APPLICABLE FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2014 & 2015)

SCHEME & SYLLABUS

DEPARTMENT OF FOOD ENGINEERING AND TECHNOLOGY
SANT LONGOWAL INSTITUTE OF ENGINEERING AND TECHNOLOGY (SLIET)
LONGOWAL-148 106
SANGRUR, PUNJAB
INDIA

Course Scheme for GFT

Semester-I (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AM-411	Engineering Mathematics	4	0	0	4	4
2	PH-411	Applied Physics	3	0	2	5	4
3	HU-411	Communication Skills/ Professional Communication	2	0	2	4	3
4	WS-411	Workshop Technology & Practice-I	2	0	4	6	4
5	ME-411	Engineering Drawing	0	0	4	4	2
6	CS-411	Elements of Computer Programming	3	0	2	5	4
7	FT-411	Introduction to Food Processing	3	0	0	3	3
		Total	17	0	14	31	24

Semester-II (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CY-421	Applied Chemistry	3	0	2	5	4
2	MC-421	Environmental Studies	2	0	0	2	2
3	EC-421	Elements of Electronics Engineering	3	0	2	5	4
4	WS-421	Workshop Technology & Practice-II	2	0	4	6	4
5	EE-421	Elements of Electrical Engineering	3	0	2	5	4
6	FT-421	Food Chemistry	3	0	2	5	4
7	FT-422	Food Microbiology	3	0	2	5	4
		Total	19	0	14	33	26

Semester-III A (UG: Practical Training)

	TP-401	Two weeks Practical Training during summer vacations				80	S/US

Semester-III B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AM-511	Higher Engineering Mathematics	3	0	0	3	3
2	CY-511	Industrial Chemistry	3	0	2	5	4
3	PH-511	Material Science	3	0	2	5	4
4	FT-511	Food Biochemistry and Nutrition	3	0	2	5	4
5	FT-512	Heat and Mass Transfer	3	0	2	5	4
6	FT-513	Unit Operations	3	0	2	5	4
		Total	18	0	10	28	23

Semester-IV (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AM-521	Numerical Analysis	3	0	2	5	4
2	MC-521	Human Values and Professional Ethics	1	0	0	1	0
3	FT-521	Food Engineering	3	0	2	5	4
4	FT-522	Biotechnology	3	0	2	5	4
5	FT-523	Dairy Engineering	3	0	2	5	4
6	FT-524	Fluid Flow Operations and Rheology	3	0	2	5	4
7	FT-525	Seminar	0	0	2	2	1
		Total	16	0	12	28	21

Semester-V (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	FT-611	Biochemical Engineering	3	0	2	5	4
2	FT-612	Technology of Cereal Processing	3	0	2	5	4
3	FT-613	Technology of Animal Products	3	0	2	5	4
4	FT-614	Food Analysis and Quality Control	3	0	2	5	4
5	FT-615	Food Storage Engineering	3	0	2	5	4
6	FT-616	Technology of Fruits and Vegetable Products	3	0	2	5	4
		Total	18	0	12	30	24

30/3/16

Semester-VI (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	FT-621	Elective-I	3	0	0	3	3
2	HU-621	Engineering Economics and Entrepreneurship	3	0	0	3	3
3	FT-622	Packaging Technology	3	0	2	5	4
4	FT-623	Technology of Fats and Oils	3	0	2	5	4
5	FT-624	Technology of Beverages	3	0	2	5	4
6	FT-625	Technology of Bakery and Confectionery Products	3	0	2	5	4
		Total	18	0	8	26	22

Semester- VII A (UG:Industrial Training)

	TP-701	Industrial Training during summer vacations (6 weeks)				200	

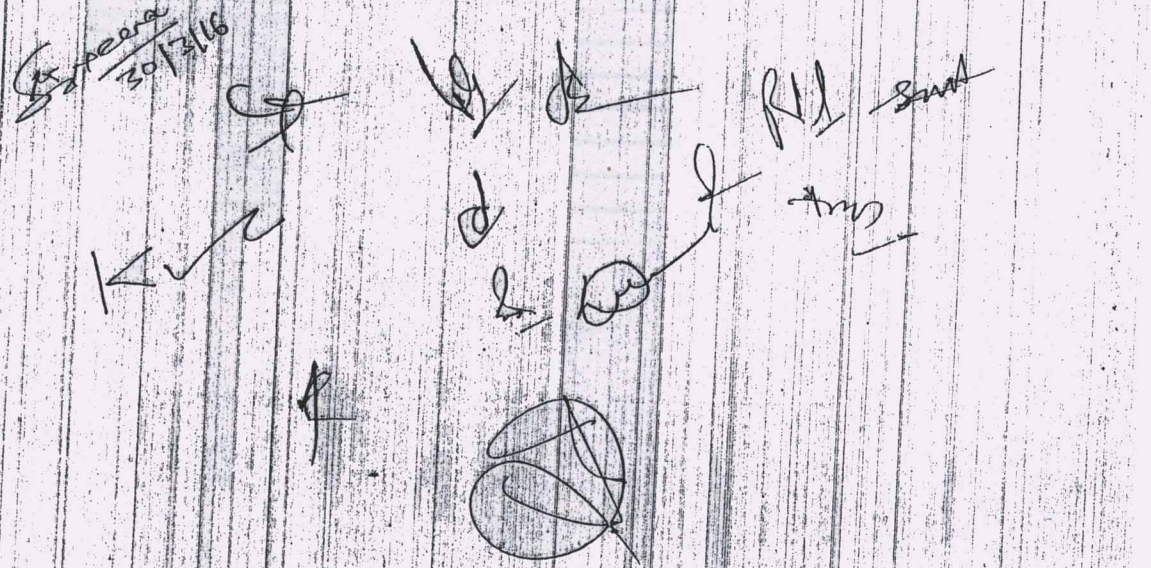
Semester-VII B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	FT-711	Spices and Flavour Technology	3	0	2	5	4
2	FT-712	Food Processing Plant Layout & Design	3	0	0	3	3
3	FT-713	Health and Functional Foods	3	0	2	5	4
4	FT-714	Elective - II	3	0	0	3	3
5	HU-711	Technical Communication & Soft Skills	2	0	2	4	0
6	FT-715	Project	0	0	4	4	2
7	TP-701E	Industrial Training (Evaluation Only)					2
		Total	14	0	10	24	18

Semester-VIII (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	FT-721	Process Technologies for Pulses and Oilseeds	3	0	2	5	4
2	FT-722	Innovative Techniques in Food Processing	3	0	0	3	3
3	FT-723	Food Laws and Regulations	4	0	0	4	4
4	FT-724	Elective-III	3	0	2	5	4
5	OP-729*	OP-Elective (Separation Technology)	3	0	0	3	3
6	FT-725	Project	0	0	8	8	4
		Total	16	0	12	28	22

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1		Elective-I					
	FT-621A	Post Harvest Engineering	3	2	0	5	4
	FT-621B	Statistical Quality Control	3	2	0	5	4
2		Elective-II					
	FT-714A	Numerical Computations in Food Processing Industry	3	0	0	3	3
	FT-714B	Industrial Microbiology	3	0	0	3	3
3		Elective-III					
	FT-724A	Technology of Snack Foods	3	0	2	5	4
	FT-724B	Food Additives and Ingredients	3	0	2	5	4



Title of the course : Engineering Mathematics
Subject Code : AM - 411
Weekly load : 4 Hrs. **LTP** 4-0-0
Credit : 4 (Lecture 4; Tutorial 0; Practical 0)

Unit	Main Topic	Detailed contents	Lectures
1	**Matrices**	Elementary transformations. Row reduced Echelon forms. Rank of a matrix. Normal form. Linearly dependent and independent vectors. System of linear equations. Linear transformations. Eigen values and eigenvectors. Properties of eigen values. Reduction to diagonal form. Verification of Cayley-Hamilton Theorem and its use for finding inverse of a matrix. Idempotent matrices. Complex matrices.	15
	Solid geometry	Cartesian co-ordinate system. Distance formula. Section formulae. Direction ratios and direction cosines. Equation of a plane. Equations of a straight line. Condition for a line to lie in a plane. Coplanar lines. Shortest distance between two lines. Intersection of three planes. Equation of a sphere. Tangent plane to a sphere. Equations of a cone and a cylinder.	15
2	**Differential equation**	Solution of differential equation by variable separable method, homogeneous differential equation of first order and their solution, Exact differential equation.	14
	Linear differential equations	Solution of linear differential equation of first order. Reducible to linear differential equation. Higher order linear differential equation with constant coefficients, complementary function and particular integral. Method of variation of parameters. Cauchy's and Legendre's equations.	16

Total=60

Recommended Books:

Author	Title	Publisher
R.K. Jain, S.R.K. Iyengar	Advanced Engineering Mathematics	Narosa Publishers
Denial A Murray	Elementary Course in Differential Equations	Longman.
Erwin Kreyszig	Advanced Engineering Mathematics	Wiley Eastern Limited
B.V. Ramana	Higher Engineering Mathematics	McGraw Hill.

Title of the course : Applied Chemistry
Subject Code : CY-411
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 1)

Unit	Main Topic	Detailed contents	Lectures
1	**Electro-analytical Chemistry**	Conductivity of electrolytes- Specific, molar and equivalent conductivity, Nernst equation for electrode potential, EMF series, hydrogen electrode, calomel electrode, glass electrode, Electrolytic and galvanic cells, cell EMF, its measurement and applications, reversible and irreversible cells, concentration cell, electrode (hydrogen gas electrode) and electrolyte concentration cell, concentration cell with and without transference. Potentiometry: Principle, instrumentation and applications.	9
	Fuels	Classification, examples, relative merits, Solid Fuels: Coal, Proximate and Ultimate analysis of coal. Gross and Net Calorific Value, Determination of calorific value by Bomb Calorimeter Carbonization process, Low and High Temperature Carbonization. Liquid fuels: Cracking, Thermal and Catalytic Cracking, Synthetic petrol, Knocking, Anti knocking, Octane number, Cetane Number. Anti knocking agents. Gaseous fuels: Biogas, LPG and CNG. Determination of calorific value by Junker's Calorimeter. Flue gas analysis by Orsat's apparatus, problems.	10
	Surface Chemistry	Adsorption, chemisorption and physisorption, application of adsorption of gases on solids. Langmuir's adsorption isotherm, Freundllch's adsorption isotherm, BET theory of multi-layer adsorption (qualitative), adsorption chromatography. Colloidal particles, surfactants, micelles. Enzyme catalysis, Criteria for choosing catalyst for industrial processes.	9
2	**Engineering Materials**	Abrasives – Moh's scale of hardness – natural abrasives (diamond, corundum, emery, garnets and quartz) – synthetic abrasives (silicon carbide, boron carbide) – refractories – characteristics – classification (acidic, basic and neutral refractories) – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina magnesite and zirconia bricks.	10
	Lubricants	Classification of lubricant, lubricating oils, semisolid lubricants, solid and synthetic lubricants. Properties of lubricating oils (viscosity, flash and fire points, cloud and pour point, Iodine Value, Acid Value, R. M. Value, mechanical stability and saponification number).	7

Total=45

Recommended Books:

Author	Title	Publisher
P. C. Jain & M. Jain	Engineering Chemistry	Dhanpat Rai Publishing Company, New Delhi, 2005
B.R. Puri, L.R. Sharma, M.S. Pathania	Principles of Physical Chemistry	Vishal Publishing Company, 2008
F.W. Billmayer	Textbook of Polymer Science. 3rd Edn	Wiley. N.Y. 1991
C. N. Banwell & E.M.	Fundamentals of Molecular	Tata Mc Graw-Hill Edition,

McCash	Spectroscopy, 4th Edn.	1995
S. S. Dara, S. S. Umare	A Text Book of Engineering Chemistry	S. Chand Publishing, 2011
J. D. Lee	Concise Inorganic Chemistry, 5th Edn.	Chapman and Hall, London, 1996
B. Sivasankar	Engineering Chemistry	Tata Mcgraw Hill
A. Mallick	Engineering Chemistry	Viva Books, 2008
J. Clayden, Nick Greeves, S. Warren	Organic Chemistry	Oxford Press 2012
. Levine,	Physical Chemistry, 5/e (7th reprint)	Tata McGraw Hill, 2006
J.E. Huheey, E.A. Keitler, R.L. Keita, O.K. Medhi	Inorganic Chemistry, Principle, structure and reactivity	Pearson Education, 4th Edn.
J.E. Mcmerry and R.C. Fay	Chemistry, 5th Edn.	Pearson Education, 2008

CY-411(P)
Applied Chemistry Lab
(Any twelve to be performed)

1. Determination of strength of unknown solution of Mohr's salt using $KMnO_4$ and standard oxalic acid solution.
2. Determination of ferrous, ferric and total iron in a given sample using standard $K_2Cr_2O_7$
3. Determination of copper in a given solution by iodometric method using $Na_2S_2O_3$ and standard $K_2Cr_2O_7$
4. To find out the cell constant of a conductivity cell.
5. To find out the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide using pH meter.
6. To prepare and describe a titration curve for phosphoric acid-solution hydroxide titration using pH-meter.
7. Determine the strength of the given hydrochloric acid solution by titrating it against sodium hydroxide conduct metrically.
8. Determination of EMF/oxidation/reduction potential of a given metal/metal ion in different conditions.
9. Determination of equilibrium constant of a reaction by potentiometric method.
10. To determine moisture and volatile contents in a given coal sample by proximate analysis.
11. To determine fixed carbon and ash contents in a given coal sample by proximate analysis.
12. To study the adsorption of acetic acid on active charcoal and to verify the Freundlich and Langmuir isotherm.
13. To study the adsorption of Iodine from alcoholic solution by charcoal.
14. Determination of viscosity of heavy oil by means of Redwood Viscometer.
15. Determination of coefficient of viscosity of the given liquids by Ostwald's Viscometer method.
16. Determination of Flash point of a given sample.
17. Determination of Fire point of a given sample.
18. Determination of acid value and saponification value of an oil.
19. Determination of aniline point of a lubricating point.
20. Determination of Iodine value of oil.
21. To determine the cloud and pour point of a lubricating oil.

Title of the course : Communication Skills
Subject Code : HU-411
Weekly load : 4 **LTP** 2-0-2
Credit : 3 (Lecture 2; Practical 1)

Unit	Main Topic	Detailed contents	Lectures
1	**Communication Techniques**	Importance of Communication, One-way and Two-way Communication, Essentials of Good and effective Communication, Barriers to Communication, Techniques to Overcome Barriers	8
	Writing Skills	Précis- writing; Essay- writing, Official e-mail writing	8
2	**Report Writing**	Reports and their importance, Types of Routine Reports along with their formats- Annual Confidential Report, Progress Report, Inventory Report, Inspection Report, Lab Report, Structure of Reports; Bibliography & References	8
	Grammar & Vocabulary	Tenses, Change of Voice, Change of Narration, Words often confused, Correct use of Prepositions, Use of Idioms and Phrases	8

Total=32

Recommended Books:

Author	Title	Publisher
Bhattacharya, Indrajit	An Approach to Communication Skills	Dhanpat Rai & Co
Gibaldi, Joseph	MLA Handbook for Writers of Research Papers	MLA
Sinclair, John	Collins Cobuild English Grammar	Collins
Wren, P.C. & H. Martin	High School English Grammar & Composition	S. Chand & Company Ltd
Sharma, R.C. & Krishna Mohan	Business Correspondence and Report Writing	Tata McGraw-Hill

HU-411(P)
Communication Skills Lab

1. Introducing yourself.
2. Observing and analyzing your environment/ surroundings.
3. Collecting and Using Library Resources.
4. Giving Individual Presentations.
5. English Conversation Skills.
6. Group Discussions.
7. Extempore.
8. Debates.
9. Summarizing newspaper reports.
10. Role Plays.
11. Grammar exercises.
12. Finalization of Team Project Work.
13. Collecting Materials for Project Work & Finalization of Project.
14. Presentation of Project.

Title of the course : Workshop Technology & Practice-I
Sub code : WS-411
Weekly load : 6 hrs **LTP** 2-0-4
Credit : 4 (Lecture 2; Practical 2)

Unit	Main topic	Detailed contents	Lectures
1	**Sheet Metal**	Introduction to sheet metal work; GI sheets, aluminium, tin plate, copper, brass etc, Hand tools used in sheet metal shop like steel rule, Vernier callipers, micrometer, sheet metal gauge etc., scriber, divider, punches, chisels, hammers, snips, pliers, stakes, rivets etc., Operations -shearing, bending, drawing, squeezing etc.	6
	Pattern making	Introduction to pattern making, moulding and foundry practice. Pattern materials like wood, cast iron, brass, aluminium, waxes etc., different types of patterns, pattern allowances.	6
	Foundry	Introduction to casting process, core-boxes, core prints, hand tools-shovel, riddle, rammer, trowel, slick, lifter, sprue pin, bellow, mallet, vent rod, pouring weights etc., moulding sands-green sand, dry sand, loam sand, facing sand etc., grain shape and size, properties of moulding sand, sand preparation and testing etc., casting- permanent mould casting, centrifugal casting etc.	8
2	**Carpentry**	Introduction to wood working, Types of wood, seasoning methods, Marking and Measuring Tools-rule, try square, marking gauge, mortise gauge etc., Cutting Tools-rip saw, tenon saw, firmer chisel, mortise chisel, iron jack plane, wooden jack plane etc., Drilling Tools-braces, drill bits etc., Striking Tools-hammers, mallet etc., Holding Tools-bench vice, G-cramp etc., Miscellaneous Tools- rasps, files, screw driver, pincer etc.; Operations-marking, sawing, planning, chiselling, boring, grooving etc., Joints- Corner joints, Tenon and Mortise joint, Briddle cross-joint.	6
	Fitting	Introduction to fitting, Tools used in fitting -bench vice, hammers, chisels, files-flat file, square file, half round file, round file, knife edge file, scrapers, hacksaws, try squares, drill machine, drill bits, taps, dies etc, Operations-chipping, filing, scrapping, sawing, marking, drilling, tapping, dieing etc.;	6

Total=32

Recommended Books:

Author	Title	Publisher
Hajra Choudhury, Hazra Choudhary and Nirjhar Roy	Elements of Workshop Technology, vol. I	Media promoters and Publishers Pvt. Ltd
W A J Chapman	Workshop Technology, 1998, Part -1, 1st South Asian Edition	Viva Book Pvt Ltd
P.N. Rao	Manufacturing Technology, Vol.1, 3rd Ed.	Tata McGraw Hill Publishing Company.
Kaushish J.P	Manufacturing Processes	Prentice Hall India

WS-411(P)
Workshop Technology and Practices Lab

1.CARPENTRY SHOP

Making of various joints like:

a) Cross lap joint
b) T-lap joint
c) Corner lap joint
d) Mortise and tenon joint
e) Dovetail joint

2. FITTING SHOP

a) Study and use of instruments in fitting shop, like, vernier calipers, micrometer, heigh gauge and bevel protractor
b) Exercise on simple operation viz. cutting, chipping, sawing, filing, drilling,

3. FOUNDRY SHOP

a) Familiarization with different patterns and hand tools.
b) Preparations of green sand mould using single piece pattern three-four exercises.
c) Preparations of green sand mould using split pattern on bench moulding.
d) Preparations of green sand mould using solid pattern by bedded method.

4. PATTERN SHOP

a) Familiarization with different tools and patterns in pattern shop.
b) Exercise on making of solid piece pattern
c) Exercise on making of split piece pattern
d) Exercise on making of cored pattern.

5. SHEET METAL SHOP

a) Study the layout and different equipment used in sheet metal shop.
b) Familiarization with different tools and processes in sheet metal shop.
c) Exercise on sheet cutting, development, folding, bending, piercing, punching, parting, notching and slitting.
d) Profile and circle cutting exercise.

Title of the course : Engineering Drawing
Subject Code : ME-411
Weekly load : 04 **LTP** 0-0-4
Credit : 02

Unit	Main topic	Detailed contents	Lectures
1	**Introduction**	Introduction, Objectives, applications. Fundamentals of engineering drawing, Use and handling of different drawing instruments, title block, sheet sizes, first and third angle projections, orthographic projections.	4
	Lettering and Dimensioning	Free hand sketching of different types of lines in engineering drawing as per IS specifications, Free hand lettering (alphabet and numerals) - lower case and upper case, vertical and inclined at 75^0 in the ratio of 7:4, Notation of dimensioning, size and location dimensions, aligned and unidirectional systems of dimensioning, general rules for dimensioning, unit of dimensioning.	4
	Scales	Uses of scales, sizes of scale, representative fraction, construction of plain and diagonal scales	6
	Projection of points, line	Introduction on theory of projections and orthographic projections, projection of a point in different quadrants, projection of straight lines in different positions (all possible cases)	12
2	**Projection of Planes**	Definition of plane, types of planes, traces of plane, projection of planes in different positions	6
	Projection of Solids	Types of solids, projections of solids in simple and typical positions, introduction on sectioning of solids	8
	Development of surfaces	Introduction, Development of a right prism, cylinder, pentagonal prism, and a right pyramid, truncated pentagonal pyramid.	8

Total = 48

Recommended Books:

Author	Title	Publisher
P S Gill	Engineering Drawing	Kataria and Sons, New Delhi
R.K.Dhawan	Engineering Drawing	S. Chand & Co, New Delhi
N.D,Bhatt	Engineering Drawing	Charotar Publishing House

Title of the course : Elements of Computer Programming
Subject Code : CS-411
Weekly load : 6 Hrs. **LTP** 2-0-4
Credit : 4 (Lecture 2, Practical 2)

Unit	Main Topic	Detailed contents	Lectures
1	**Introduction**	Elements of computer processing, Hardware and software, Introduction and feature wise comparison of various Operating Systems, Including DOS, Windows and Linux, Problem solving-algorithms and flowcharts. Structured Programming vs. Object Oriented Programming.	4
	C Programming Basics	Basic program construction, Structure of a C program, Compilation process, pre-processor directives, Comments, Data types, Type conversions, Operators - arithmetic, Relational, Logical, Conditional, Increment/decrement, Library functions, Header files.	4
	Loops and Decision Statements	For loop, while loop, do loop, Various forms of if statement,switch statement, break statement, continue sta tement, go to statement.	3
	Arrays	arrays and strings, Declaring an array, Initializing arrays, Accessing the array elements, Working with multidimensional arrays, Declaring and initializing string variables, Arithmetic operations on characters, String handling functions.	4
2	**Functions**	Defining functions, Passing arguments to functions, Returning values from functions, Reference arguments, Variables and storage classes, Static functions.	5
	Pointers	Pointers, Pointers to pointers, Declaring and initializing pointers, Pointer expressions, Pointer increment and scale factor, Pointers and arrays, Pointers and strings.	5
	Structures and Union	Declaring and initializing a structure, Accessing the members of a structure, Nested structures, Array of structures, Using structures in functions, Pointers and structures, Declaring and initializing a union.	3
	Files	Reading and writing to text and binary files, Character I/O, String I/O, File pointers, Error handling, Redirection, Command line arguments.	4

Total=32

Recommended Books:

Author	Title	Publisher
Kernighan Brian W. and Ritchie, Dennis M	The C Programming language	Dorling Kingsley.
Balagurusamy, E.	Programming in ANSIC	TMH Publications

CS-411 (P)

Elements of Computer Programming Lab

1. WAP to find multiplication of two numbers.
2. WAP to swap two numbers without using third variable.
3. WAP to calculate temperature in Fahrenheit to Celsius using formula C= (F- 32)/1.8.
4. WAP to calculate Sum and Average of N numbers using sequence of statements.
5. WAP to convert integer arithmetic to a given number of day and month using switch case.
6. WAP to find maximum out of 3 numbers a, b &c using Control Statements (if, else, nested if, nested else).
7. WAP to find minimum out of 3 numbers a, b & c using Control Statements (if, else, nested if, else)
8. WAP to find whether entered number is palindrome or not.
9. WAP to check entered number is even or odd.
10. WAP to find whether entered year is leap year or not.
11. WAP to find factorial of positive integer using for loop.
12. WAP to print all the number between 1 to 100 which are divisible by7 using the concept of loops.
13. WAP to generate Fibonacci series up to n using loops.
14. Write a program to calculate area of circle using function.
15. Write an iterative function to calculate factorial of given number.
16. Write a recursive function to calculate factorial of given number
17. WAP to find even & odd up to a given limit using the concept of array and loops.
18. WAP to reverse a string.
19. WAP to find addition of two matrix of n*n order using the concept of 2 dimensional array
20. WAP to find multiplication of two matrix of n*n order using the concept of 2 dimensional array.
21. WAP program to study the concept of structure.
22. WAP to implement the concept of switch and break statements.
23. WAP to implement the concept of continue statements.
24. WAP to create a data file, retrieve data from the file.

Title of the course : Introduction to Food Processing
Subject Code : FT-411
Weekly load : 3 **LTP** 3-0-0

Credit : 3 (Lecture 3; Practical 0)

Unit	Main Topic	Detailed contents	Lectures
1	**Introduction**	Introduction to food processing: scope and importance; basic concepts about properties of foods: liquid, solid and gases; unit operations; water activity;	4
	Basics of unit operation	Processing at ambient temperatures: theory and equipment for raw material processing, size reduction, mixing and forming, separation and concentration of food components, irradiation.	6
	Cereal and legumes	Cereals and Legumes: Structure, pre-treatments, processing, storage, use in various preparation. Cereal products, breakfast cereals, fast food.	4
2	**Milk and Milk Products**	Milk and Milk products: Composition, Classification, Selection, Quality, Processing, Storage and uses in different preparations, Nutritional aspects, shelf life and spoilage.	6
	Animal and animal products	Meat, Fish and Poultry: Types, Selection, Purchase, Storage, Uses, preparations, Spoilage of fish, poultry and meat. Eggs: Production, grade, quality selection, storage and spoilage, cost nutritional aspects and use in different preparations.	7
	Fruits &Vegetables	Vegetables and Fruits: Variety, selection, purchase, storage, availability, causes and nutritional aspects of raw and processed products and their use in different preparations.	7
	Food microbiology and spoilage.	Introduction to important microorganisms in foods. Cultivation of microorganisms, nutritional requirements of microorganisms, types of media used, methods of isolation. Sterilization and disinfection. Contamination and microorganisms in the spoilage of different kinds of foods.	8
			Total=42

Recommended books:

Author	Title	Publisher
G. W. Gould	New Methods of Food Preservation	CRC
R.P.Singh	Introduction to Food Engineering	CRC
Barbosa-Canovas	Novel Food Processing Technologies	CRC

Title of the course : Applied Physics
Subject Code : PH-421
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 1)

Unit	Main Topics	Detailed contents	Lectures
1	**Relativity**	Newtonian mechanics and Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, time dilation and length contraction, space-time interval, twin paradox, relativistic addition of velocities, variation of mass with velocity, mass energy equivalence, relativity and Doppler effect	12
	Quantum Mechanics	Need of quantum mechanics, Basis of quantum mechanics, wave function, Schrödinger's time-independent and time-dependent equations, expectation values of physical quantities (position, momentum and energy), applications of time independent equation; for a particle in a box (one dimensional), step potential, finite square well potential, tunnelling effect	12
2	**Radiation Physics And Lasers**	Elementary ideas about interaction of charged particles, electromagnetic radiations and neutrons with matter, detection of radiations by: proportional counter, GM counter, scintillation detectors, solid state detectors (basic principle only), applications of radiations in industry, agriculture and health science, radiation hazards. Principle of lasers, types of lasers : He-Ne, Ruby, CO_2 and semiconductor laser, Applications of Lasers.	12
	Fiber Optics	Optical Fiber, physical structure and basic theory, modes in optical fibers, step index and graded index fibers, losses in optical fibers, Sources and sensors for optical fibers, applications of Optical fibers in communication.	6
	Electrodynamics	Gauss's law in dielectric medium, Equation of continuity, displacement current, Maxwell's equations, wave equation for electromagnetic radiation, electromagnetic wave propagation in free space and isotropic dielectric medium, Poynting theorem & Poynting vector, vector potential, Lorentz gauge.	6

Total=48

Recommended Books:

Author	Title	Publisher
Arthur Beiser	Concepts of Modern Physics	McGraw Hill
C. Kittel	Introduction to Solid Satate Physics	John-Wiley & Sons
Serway, Moses and Moyer	Modern Physics	Thomson

PH-421(P)

Applied Physics Lab

1. To find the value of Planck's constant by using a Photoelectric cell.
2. To verify inverse square law of radiation using a photoelectric cell.
3. To determine the frequency of an unknown signal by drawing the Lissajous patterns for various frequency ratios and evaluate the face difference between two sinusoidal signals applied to X and Y input of cathode ray oscilloscope.
4. To measure the velocity of ultrasonic waves through a given liquid medium.
5. Measurement of wavelength of given He-Ne LASER by diffraction method.
6. To determine the wavelength of a sodium (Na) light by using the Michelson's Interferometer.
7. Determination of the value of e/m of an electron by helical method.
8. To determine the numerical aperture (Na) of a given multimode optical fiber by using Laser beam.
9. To determine the g – factor by using ESR Spectrometer.

Title of the course : Environmental Studies
Subject Code : MC-421
Weekly load : 2 **LTP** 2-0-0
Credit : 2 (Lecture 2)

Unit	Main Topic	Detailed contents	Lectures
1	**Ecology and environment**	Ecosystem; components, functioning, food chain and web, ecological pyramids. Biogeochemical cycles; water cycle, carbon cycle, nitrogen cycle. Biodiversity and its conservation.	8
	Sustainable development	Sustainable development; conflict between development and environmental conservation, international endeavors. Sustainable utilization of resources; energy resources, water resources, forest resources.	8
2	**Environmental pollution**	Water pollution; wastewater characterization, primary treatment, secondary biological treatment, general discharge standards. Air pollution; major pollutants, treatment devices, ambient standards. Solid waste management.	10
	Environmental Regulations	Green House Effect and Kyoto Protocol. Ozone layer depletion and Montreal Protocol. Environment Protection Act. Hazardous waste management.	6

Total=32

Recommended Books:

Author	Title	Publisher
E. Bharucha	Textbook for Environmental Studies	UGC Publication
K.D. Wanger	Environmental Management	W.B. Saunders Publication
E.P. Odum	Fundamentals of Ecology	W.B. Saunders Publication
Pollution Control Acts, Rules and Notifications		CPCB Publication.

Title of the course : Elements of Electronics Engineering
Subject Code : EC-421
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Tutorial 0; Practical 1)

Unit	Main Topic	Detailed contents	Lectures
1	**Semiconductors**	Semiconductors p-type, n-type, pn junction diodes, pn junction as a circuit element, its characteristics, half wave and full wave and bridge type rectifier circuits basic filter circuits, Doide as voltage multiplier, clipper & clamper circuit. Zener diode as a voltage regulator. LED its characteristics construction & applications	12
	Amplifiers	Concept of d.c. and a.c. load line and operating point selection. Various amplifiers configurations their h-parameter equivalent circuits determination of voltage gain current gain input resistance and output resistance & power gain. Concept of feedback in amplifiers, different oscillators circuits (without analysis) Differential amplifier and its transfer characteristics.	12
2	**Operational Amplifiers**	IC Op-Amps, its ideal & practical specifications and measurement of parameters. Op-Amp in different modes as inverting amplifier non inverting amplifier scale changer, differentiator & integrator.	12
	Transistors	Characteristics of JFET, MOSFET, Various amplifier configurations using FET. Characteristics and Construction of SCR, TRIAC, UJT. Their basic areas applications.	12

Total=48

Recommended Books:

Author	Title	Publisher
Boylstad & Nashelsky	Electronic Devices & Circuits	
Millman & Halkias	Integrated Electronics	McGraw Hill
Malvino	Electronic Principles	
V.K. Mehta, Shalu Melta	Principles of Electronics	
Donald L. Shilling & Charles Belowl	Electronic Circuits	

EC-421(P)
Elements of Electronics Engineering Lab

1. To study single stage amplifiers and calculate its gain
2. To study the two stage R-C coupled amplifiers and calculate its gain
3. To study the two stage R-C coupled amplifier's frequency response
4. To study the frequency response of single stage amplifier
5. To study the voltage feedback amplifiers
6. To study the Wein bridge oscillator
7. To study the Hartley oscillator
8. To study the class-B push pull amplifier
9. To study the tuned collector oscillator
10. To study the crystal oscillator
11. To study the basic principles of R-C oscillator i.e. phase oscillator
12. To study the negative feedback, its merits, demerits and calculate its gain

Title of the course : Workshop Technology & Practice-II
Sub code : WS-421
Weekly load : 6 **LTP** 2-0-4
Credit : 4

Unit	Main topic	Detailed contents	Lectures
1	**Turning and shaping**	Principle, description and functions of a lathe, specifications, work holding devices, tool materials and various operations. Description of a shaper, specifications, quick return mechanism, operations that can be performed on a shaping machine.	6
	Milling and drilling	Principle, types of milling machines, specifications of a milling machine, multipoint cutting tool, Types of milling cutters, various operations. Description of a drilling machine, types of drilling machines, twist drills, speed and feed in drilling.	8
	Forging	Introduction to forging, cold and hot forging, tools used, flow lines, importance of forging process and limitations, various gorging operations.	6
2	**Arc welding**	Definition, classification of welding processes, Principle of arc welding, welding power source, welding electrodes, coding and coating of welding electrodes, welding parameters, Types of weld joints, welding positions, advantages, limitations and applications.	6
	Gas welding	Definition, oxy-acetylene welding, types of welding flames, welding techniques, welding filler rods and fluxes, welding torches and blow pipes, acetylene gas generator, gas cylinders and regulators, advantages, disadvantages and applications of gas welding	6

Total=32

Recommended Books:

Author	Title	Publisher
Hajra Choudhury, Hazra Choudhary and Nirjhar Roy	Elements of Workshop Technology, vol. I	Media promoters and Publishers Pvt. Ltd
W A J Chapman, Workshop Technology	Part -1, 1st South Asian Edition	Viva Book Pvt Ltd
P.N. Rao	Manufacturing Technology, Vol.1, 3rd Ed.	Tata McGraw Hill Publishing Company
Kaushish J.P	Manufacturing Processes	Prentice Hall India
R.S. Parmar	Welding processes technology	Khanna Publishers, New Delhi

WS-421(P)

Workshop Technology and Practice-II Lab

1. MACHINE SHOP

1. Practice of turning operation on lathe
2. Practice of facing operation on lathe
3. Practice of taper turning on lathe
4. Practice of knurling on lathe.
5. Practice of producing rectangular block on shaping machine.

2. FORGING SHOP

1. Exercise on conversion of round to square with cold forging.
2. Exercise on conversion of round to square with hot forging.
3. Upsetting operation exercise.
4. Exercise on swaging.

3. ARC WELDING SHOP

1. To practice making of a butt joint on a flat piece
2. To practice making of lap joint on a flat piece
3. To practice making of a corner joint.
4. To practice making of T-joint.
5. To practice making of bead on flat and horizontal position.
6. To practice making of bead on vertical inclined position.

4. GAS WELDING SHOP

1. To practice making of making different types of flames.
2. To practice making of bead in left ward position.
3. To practice making of bead in left ward position.
4. To practice making of T- joint in M.S. Round pipe.
5. To practice making of corner joint.

Title of the course :Elements of Electrical Engineering
Subject Code :EE-421
Weekly load : 5 **LTP** 3-0- 2
Credit : 4

Unit	Main Topic	Detailed contents	Lectures
1	**Basic Concepts**	Electric Charge, Current and Electromotive force, Potential and Potential Difference; Conductor, Semiconductor Insulator and dielectric; Electrical Power and Energy; Ohm's Law, Resistance and color coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel connection, Kirchoff's Laws and Their Applications	6
	AC Fundamentals	Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; RMS and Average Values, Concept of Phase and Phase Difference, Single Phase and Three Phase Supply; 3-ph Star-Delta connections, Inter-Relation between phase voltage/current & line voltage/current; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit.	8
	Measuring Instruments	Principle and Construction of Instruments used for Measuring Current, Voltage, Power and Energy, Concept and applications of digital multimeters, oscilloscopes, signal generators	3
	Electrical Safety	Electrical Shock, Safety practices to prevent Electric Shock; Concept of Fuses- Classification, Selection and Application; Concept of Earthing, Types of Earthing, MCBs, ELCBs and their Applications.	4
2	**Electromagnetic Induction**	Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in a Magnetic Field, various losses in magnetic circuits;	4
	Electrical Machines &Transformers	Elementary concepts and classification of electrical machines, Common features of rotating electrical machines, Basic principle of a motor and a generator, Need of Starters and their classifications. Transformer- Classification, Principle of operation, Construction, Working and applications.	10
	Utilization of Electricity	Concepts of Electricity for electrolysis process e.g., Electroplating, Electro refining etc., Electrochemical Cells & Batteries; Application of Electricity for Heating, Ventilating and air-conditioning, Welding and illumination.	4
	Basic Trouble shooting	Basic Testing and faults diagnosis in electrical systems, various tools and their applications, replacement of different passive components e.g. fuses, lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays.	4

Total=43

Recommended Books:

Author	Title	Publisher
Edward Hugh	Electrical Technology	Pearson Education
D P Kothari & I J Nagrath	Basic Electrical Engineering	TMH
D P Kothari & I J Nagrath	Electrical Machines	TMH
S K Bhattacharya	Electrical Machines	TMH

EE-421(P)
Elements of Electrical Engineering Lab

1. Study of various passive components and measuring instruments and their connections in electrical circuits.
2. Verification of Ohm's Law.
3. Verification of Kirchoff's laws (KCL & KVL).
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of various characteristic values of a Sinusoidal waveform with the help of CRO.
6. Measurement of voltage, current and power in RL and RLC circuits and Verification of phase angle and power factor concept.
7. Study of various types of earthings.
8. Study of various types of protection devices e.g. fuses, MCBs and ELCBs
9. Verification of Faraday's laws and Lenz's law.
10. Study of various types of DC motors and their starters.
11. Study of various types of AC motors and their starters.
12. Study of various types of transformers and Verification of turns ratio.
13. Starting and reversing various AC and DC motors.
14. Fault diagnosis and removal in general electrical connection /apparatus.

Title of the course : Food Chemistry
Subject Code : FT-421
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Development of food chemistry and its role in food processing	2
	Water	Importance of water in foods. Structure of water & ice. Concept of bound & free water and their implications. Sorption Phenomena and Sorption isotherms, examples–Dispersed systems–some basic considerations.	4
	Proteins	Nomenclature, classification, structure, chemistry and properties of amino acids, peptides, proteins. Essential and non- essential amino acids, Isolation, identification and purity of amino acids, peptides, proteins. Qualitative and quantitative analysis of amino acids and proteins. Changes during processing, protein determination methods. Physical and chemical characteristics of proteins	8
2	**Carbohydrates**	Nomenclature and classification, structure, physical and chemical properties of polysaccharides (cellulose, starch, fructans, galactans, hemi-cellulose, pectic substances) and their functions; dietary fiber, changes in carbohydrates during processing**.**	8
	Lipids	Structure, classification, physical and chemical properties, utilization of fats and oils, margarine, shortenings, salad and cooking oils, importance of fats and oils in diet, introduction to hydrogenation and its importance.	6
	Browning reactions	Enzymatic and non-enzymatic browning, advantages and disadvantages, factors affecting their reaction and control	4
	Vitamins	Types of vitamins, chemistry and functions, source and deficiency diseases	4
	Plant pigment	Structure and properties of chlorophyll, anthocyanins, tannin, myoglobin and carotenoids, chemical changes during processing	4
	Flavor and aroma of foods	Importance and method of retention of flavour and aroma in foods, terpenes, esters, ketones and quinines.	4

Total=44

Recommended Books:

Author	Title	Publisher
Meyer	Food Chemistry	CBS
Fenemma	Food Chemistry	
Belitz	Basic Food Chemistry	CBS
Lehninger	Principles of Biochemistry	

FT-421 (P)
Food Chemistry lab

1. Qualitative tests for the presence of carbohydrates in food samples
2. Qualitative test for the presence of protein in food and its products
3. Estimation of sugar in given food sample by Lane and Eynon and Nelson& Somogy method
4. Estimation of lactose in milk sample by titrimetric method
5. Determination of browning content and inhibition of browning reaction
6. Determination of acid value of given oil or fat sample
7. Estimation of amount of fat milk powder by Majonnier's method
8. Estimation of protein by micro-Kjeldhal method
9 Estimation of pectic substances and pectin in fruit
10 Determination of Vitamin B-complex in foods
11 Determination of saponification value and un-saponifiable matter
12 Determination of RM value, Polenske value of oil and fat.
13 Determination of proline content.
14 Determination of vitamin C in given sample.
15 Estimation of phosphatase activity in milk.

Title of the course : Food Microbiology
Subject Code : FT-422
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Importance and historical developments in food microbiology, prokaryotic and eukaryotic cell, morphology, structure, microbiology and reproduction of bacteria, yeast and mold.	8
	Techniques of pure culture	Serial dilution, pour plate, streak plate, spread plate, slant, broth and enrichment culture, lyophilization.	4
	Microbial growth and death kinetics	Definition, growth curves (different phases), synchronous growth, doubling/generation time, intrinsic and extrinsic factors, relationship between number of generations and total number of microbes.	8
2	**Microbiology and microbial spoilage of Food Products**	Microbiology of raw milk and fermented milk products *viz*. yoghurt, cheese; cereals products, fruits and vegetable, meat and meat product, egg and fish.	10
	Food spoilage	Bacterial and fungal food spoilage, food poisoning, food borne infection, food borne intoxication. Toxins produced by Staphylococcus, Clostridium, Aspergillus; bacterial pathogens-Salmonella, Bacillus, Listeria, E. coli, Shigella, Campylobacter.	10
	Microbial Control	Source of microorganisms, Physical and chemical agents used in microbial control, disinfected agents and its dynamics.	4

Total=34

Recommended Books:

Author	Title	Publisher
W.C. Frazier	Food Microbiology	Tata McGraw Hill
H.J. Pleczar	Microbiology	Chapman and Hall
J. Heritage	Introductory Microbiology	

FT-422 (P)
Food Microbiology Lab

1. To study the working of various equipments related to Microbiology.
2. To isolate pure culture using pour plate technique.
3. To isolate pure culture using spread plate technique.
4. To isolate pure culture using pour plate technique.
5. To measure the size of given microbial cell using micrometery.
6. To enumerate total viable count in a culture.
7. To perform Gram staining technique of bacteria.
8. To study the growth curve of microorganisms.
9. Quantitative analysis of food sample by standard plate count (SPC) method.
10. To study quality of milk by methylene blue reductase test.
11. Demonstration of microbial production of curd.
12. To perform presumptive test for coliforms in milk.
13. To study the bacterial survival against UV irradiations.
14. To study the bacterial spoilage of given food sample.

Title of the course : Higher Engineering Mathematics
Subject Code : AM - 511
Weekly load : 3 Hrs. **LTP** 3-0-0
Credit : 3 (Lecture 3; Tutorial 0; Practical 0)

Unit	Main Topic	Detailed contents	Lectures
1	**Laplace transforms**	Laplace transforms of elementary functions. Properties of Laplace transform. Transform of derivatives and integrals. Evaluation of integrals by Laplace transforms. Inverse Laplace transforms. Convolution theorem. Solution of ordinary differential equations. Unit step function and unit impulse function. Engineering applications.	7
	Fourier series	Fourier series. Change of interval. Even and odd functions. Half-range series.	5
	Partial derivatives and expansions	Functions of two or more variables. Partial derivatives. Homogenous functions. Euler's Theorem. Total derivative. Derivative of an implicit function. Tangent and normal to a surface. Change of variables. Jacobians. Taylor's and Maclaurin's series expansions for a function of two variables.	9
2	**Complex functions**	Limit of a complex function. Differentiation. Analyticity. Cauchy-Riemann equations. Harmonic functions. Conformal mapping. Some special transformations-translation, inversion and rotation. Bilinear transformation.	7
	Multiple integral	Double integral. Change of order of integration. Triple integral. Change of variables. Applications to area and volume. Beta and Gamma functions.	8
	Vector Calculus	Differentiation of a variable vector. Scalar and vector point functions. Vector operator - Del. Gradient, curl and divergence - their physical interpretation and applications. Directional derivative. Line, surface and volume integrals. Theorems of Green (in plane), Gauss and Stoke (without proof) - their verification and applications.	9

Total=45

Recommended Books:

Author	Title	Publisher
R.K. Jain & S.R.K. Iyengar	Advanced Engineering Mathematics	Narosa Publishers
G.B. Thomas & R.L. Finney	Calculus: Analytical Geometry	Addison Wesley
Erwin Kreyszig	Advanced Engineering Mathematics	Wiley Eastern
B.V. Ramana	Higher Engineering Mathematics	McGraw Hill

Title of the course : Industrial Chemistry
Subject Code : CY-511
Weekly load : 5 **LTP** 3-0-2
Credit : 4(Lecture 3; Practical 1)

Unit	Main Topic	Detailed Contents	Lectures
1	**Water and its treatment**	Water and its Treatment: Introduction, Hardness and its determination, Degree of Hardness, Treatment and Purification of water for domestic and Industrial purposes-Sedimentation, Filtration, Sterilization, Break point chlorination, Ozonization ,Water for Steam Making: Sludge and scale formation and Caustic embrittlement. Methods of boiler water treatment Lime-Soda process (hot and cold lime soda process), Permutit or Zeolite process, Deionization or Demineralization, Desalination of Brackish Water. Numerical Problems	12
	Corrosion	Direct chemical corrosion and electrochemical corrosion and their Mechanism, Types of corrosion, Concentration cell corrosion, atmospheric corrosion, Passivity, Pitting corrosion, factors influencing corrosion, Polarization, over potential and its significance, Factors affecting corrosion, protection from corrosion by metallic coatings, electroplating, electroless plating and cathodic protection, Chemical conversion coatings and organic coatings- Paints, enamels.	7
	Phase Rule and distribution law	Definitions (phase, component, degree of freedom, phase equilibrium), Gibbs phase rule, One component System (water system, Carbon dioxide system, sulphur system), Two component system(Pb-Ag System, KI-water system, Sodium sulphate water system) ,Nernst distribution law, Applications of distribution law: solvent extraction.	7
	Polymers	Polymerization, types of Polymerization reaction and mechanism of polymerization, molecular weight determination-Viscometry, light scattering methods. Study of some commercially important polymers (PVA, FLUON, PC, Kevlar, ABS polymer, phenolic & amino resins, epoxy resins and polyurethanes), Engineering applications of polymeric materials, Conductive polymers.	7
2	**Spectroscopic Techniques for Analysis**	Introduction, interaction of EMR radiation and matter**,** atomic and molecular spectroscopy, Absorption laws. Atomic absorption spectroscopy: Basic principles, instrumentation, interferences, typical applications. Atomic emission spectroscopy: Basic principle, instrumentation and applications. UV-VIS and IR Spectroscopy-Introduction, theory, instrumentation, applications of UV & IR spectroscopy (including finger print region in IR)	12

Total=45

Recommended Books:

Author	Title	Publisher
P. C. Jain & M. Jain	Engineering Chemistry	Dhanpat Rai Publishing Company, New Delhi.
B.R. Puri, L.R. Sharma, M.S. Pathania	Principles of Physical Chemistry	Vishal Publishing Company
F.W. Billmayer	Textbook of Polymer Science. 3rd Edn	Wiley. N.Y.
C. N. Banwell & E.M. McCash	Fundamentals of Molecular Spectroscopy, 4th Edn	Tata Mc Graw-Hill Edition
S. S. Dara, S. S. Umare	A Text Book of Engineering Chemistry	S. Chand Publishing
J. D. Lee	Concise Inorganic Chemistry, 5th Edn.	Chapman and Hall, London
B. Sivasankar	Engineering Chemistry	Tata Mcgraw Hill
A. Mallick	Engineering Chemistry	Viva Books
J. Clayden, Nick Greeves, S. Warren	Organic Chemistry	Oxford Press 2012
Levine	Physical Chemistry, 5/e (7th reprint),	Tata McGraw Hill
J.E. Huheey, E.A. Keitler, R.L. Keita, O.K. Medhi	Inorganic Chemistry, Principle, structure and reactivity	Pearson Education.
J.E. Mcmerry and R.C. Fay	Chemistry	Pearson Education

CY-511(P)

Industrial Chemistry Lab

(Any twelve to be performed)

1.) Determination of Total Hardness of water (tap, lake, pond, river) using standard EDTA solution and Eriochrome Black Tea (EBT) indicator.
2.) Determination of Available Chlorine in treated and untreated water titrimetrically.
3.) Determination of Available Chlorine in Bleaching Powder titrimetrically
4.) Analysis of water samples by BOD and COD.
5.) Estimation of Iron in water.
6.) Investigation of rusting of iron in different condition of rusting of iron.
7.) Investigation of the effect of metal coupling on rusting of iron.
8.) Study of phase rule of one component system
9.) Study of phase rule of two component system
10.) To determine the partition coefficient or distribution coefficient of iodine between CCl_4 and H_2O
11.) Preparation of Nylon 66
12.) Preparation of Polymers (Polystyrene)
13.) Preparation of urea –formahaldehyde resin
14.) Preparation of phenol–formahaldehyde resin (Bakellite)
15.) To determine the molecular weight of a polymer (polystyrene) by using viscometric method.
16.) Identification of functional group by FT-IR spectroscopy
17.) Determination of concentration of an unknown sample of UV spectroscopy.
18.) To determine λ max (wavelength of maximum absorption) of a solution of KMnO4 using a spectrometer.

Title of the course : Material Science
Subject Code **:** PH-511
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 1)

Unit	Main Topic	Detailed contents	Lectures
1	**Elements Of Crystallography**	A brief Introduction to material science, Space lattices, Unit cell, primitive cell, Bravais lattice, Atomic packing factor, Miller Indices, directions and planes in crystal lattice (cubic and hexagonal only), distribution of atoms in lattice planes (in cubic crystal only), Important structures (NaCl, CsCl, Diamond and ZnS), structure determination; X-ray diffraction, Neutron and electron diffraction	8
	Imperfections In Crystals	Point imperfections, Frenkel, and Schottky defects and their equilibrium concentration determination, Color centres, types of color centres, generation of color centres, Edge and screw dislocation, Burger vector, Surface defects.	5
	Band Theory Of Solids	Free electron theory, Concept of energy bands, Bloch theorem, Electron in a periodic field of crystal (The Kronig – Penny Model) distinction between metal, semiconductor and insulator, effective mass of an electron, Hall effect.	6
	Nano-Materials	Fundamentals of nonmaterial's and nanotechnology, nano particles, properties of nonmaterial's, synthesis and characterisation, applications of non materials.	5
2	**Dielectric Materials**	Introduction of dielectric materials, Polarization, Different types of polarization, Electronic, ionic, orientational and space charge polarization, polarizability, Clausius-Mossotti relation, temperature and frequency dependence of polarizability, dielectric breakdown, measurement of dielectric properties, Dielectric constant, Dielectric loss, ferroelectric and piezoelectric materials, examples of materials and their applications.	8
	Magnetic Materials	Terminology and classification of engineering materials, Type of magnetism (dia, para, ferro, ferri and anti ferromagnetisms), Theory of para, dia and ferromagnetic materials, magnetic anisotropy and magnetrostriction, magnetic domains, hard and soft magnetic materials, ferrites and their applications	8
	Superconductivity	Introduction, type I & type II superconductors, Meissner's effect, isotope effect, effects of magnetic field, London's equations, penetration depth, specific heat, BCS theory (electron-lattice-electron interaction, Cooper-pair, coherence length, energy gap), high temperature superconductors, applications of superconductivity.	8

Total=48

Recommended Books:

Author	Title	Publisher
Raghvan	Materials Science	PHI
Srinivasan & Srivastava	Science of Engineering Materials	Wiley Eastern
Callister JR	Materials Science and Engg.: An Introduction	
Askeland & Phule	The Science and Engineering of Material	

PH-511 (P)
Material Science Lab

1. To prepare a metallic sample and measure the grain size using the metallurgical microscope.
2. To study the creep nature in metallic wires at room temperature.
3. To find the mobility and carrier concentration in a semiconductor sample using Hall Effect experiment.
4. To study the B-H curves of different materials using B-H curve tracer.
5. To determine the Stefan's constant using Stefan's constant kit.
6. To find the resistivity of a given semiconductor material using four probe method.
7. To find the Curie temperature of the given ferrite material.
8. To find the Curie temperature of the given ferroelectric material.
9. To calculate the dielectric constant of the given dielectric material.
10. To find the capacitance and permittivity of the given material.

Title of the course : Food Biochemistry and Nutrition
Subject Code : FT-511
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Enzymes**	Enzymes classification, specificity of enzymes, co-enzymes, co-factors, enzyme inhibitors and activators, Factors effecting enzyme activity, Enzyme kinetics, Line weaver Burk plot, Allosteric enzymes.	10
	Metabolism of carbohydrates and biological oxidation	Digestion and absorption, glycolysis, gluconeogenesis, Feeder pathway of glycolysis, disorders of carbohydrate metabolism Kreb's cycle, electron transport chain and oxidative phosphorylation.	11
2	**Metabolism of lipids**	Digestion, absorption and function of lipid, β-oxidation of fatty acids, Pathway of synthesis of fatty acids, Biosynthesis of triacylglycerol.	7
	Metabolism of Proteins	Importance of protein, digestion and absorption of proteins, nitrogen balance, Biosynthesis of protein, general catabolism of amino acids, deamination, Transamination, urea cycle, disorders of amino acid metabolism.	7
	Food Nutrition	Functions and energy values of foods, basal energy metabolism: BV, NPU, BMR, PER calculations, dietary allowances and standards for different age groups, nutritive value of Indian food, techniques for assessment of human nutritional status. Causes and preventions of malnutrition.	9

Total=44

Recommended Books:

Author	Title	Publisher
Lehninger, A.L.; Nelson, D. L. and Cox, M. M	Principals of Biochemistry	CBS
Strayer. L.	Biochemistry	
Handler, P.: Smith E.I.; Stelten, D. W	Principals of Biochemistry	AVI
Sunetra Roday	Food Science & Nutrition	

FT-511 (P)
Food Biochemistry and Nutrition Lab

1. Estimation of total sugars by Dubois method in a given food sample
2. Estimation of glucose
3. Estimation of fructose
4. Estimation of enzymatic activity in a given food sample
5. Estimation of ascorbic acid in a given food sample
6. Estimation of cholesterol content
7. Estimation of protein by Lowry method
8. Estimation of phytic acid
9. Estimation of phosphatase activity in a milk sample
10. Estimation of products of anaerobic fermentation
11. Estimation of nutritive value of given food sample
12. Estimation of calorific value by Bomb calorimeter

Title of the course : Heat and Mass Transfer
Subject Code : FT-512
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Conduction heat transfer**	Modes of heat transfer, Steady state unidirectional heat transfer with and without internal heat generation through slab, cylinder, spheres and composite geometries; insulation and its purposes, critical thickness of insulation for cylinders and spheres, Unsteady state heat transfer in simple geometry; Use of Heisler charts, Gaussian error function to solve transient heat transfer problems.	12
	Convection Heat Transfer	Natural and forced convection, dimensional analysis for free and forced convection, dimensionless numbers used in convective heat transfer, important correlations for free and forced convection.	5
	Boiling and condensation	Boiling phenomenon, hysteresis in boiling curve, nucleate and forced convection boiling; condensation phenomenon, condensation on vertical surface, outside a tube and inside horizontal tube.	5
2	**Radiation heat transfer**	Characteristics of black, grey and real bodies in relation to thermal radiation, Stefan Boltzmann law; Kirchhoff's law; Wein displacement law, Emissive power for a black body and real body, intensity of radiation, radiation between two bodies.	5
	Heat Exchanger	Classification, overall heat transfer coefficient, fouling factors, log-mean temperature difference for parallel and counter flow heat exchangers, effectiveness of parallel and counter flow heat exchanger by NTU method, Design of shell and tube heat exchanger	5
	Mass Transfer	Introduction to mass transfer, different modes of mass transfer, Mass flux and molar flux for a binary system, Fick's law of diffusion of mass transfer, Derivation of general diffusion mass transfer equation, Molecular diffusion in gases, liquids and solids having steady state equi-molar counter diffusion and through non diffusing body; Steady state equimolar counter diffusion, convective mass transfer coefficient, natural and forced convective mass transfer, dimensional analysis for free and forced convective mass transfer, important correlations of convective mass transfer; permeability of films and laminates. Unsteady state diffusion in slabs, cylinders and spheres, transient mass transfer in semi infinite medium.	12

Total=44

Recommended books:

Author	Title	Publisher
Arora & D'kundwar	A course in Heat and Mass Transfer	Dhanpat Rai &Sons
R.C. Sachdeva	Fundamentals of Engineering Heat & Mass transfer	New Age
D.S. Kumar	Heat and Mass Transfer	Kataria & Sons
R K Rajput	Heat and Mass Transfer	
K A Gavhane	Unit Operations-II	Khanna Pub

FT-512 (P)
Heat and Mass Transfer Lab

1. To determine thermal conductivity of a material.
2. To find the thermal diffusivity of a food material.
3. To find out the Overall heat transfer co-efficient for a viscous food material assuming negligible internal thermal resistance (lumped heat capacity system).
4. To calculate the surface and centre temperature of a rectangular body loosing heat to the surrounding by use of Heisler and correction factor chart.
5. To calculate the surface and centre temperature of a cylindrical body loosing heat to the surrounding by use of Heisler and correction factor chart.
6. To calculate the surface and centre temperature of a spherical body loosing heat to the surrounding by use of Heisler and correction factor chart.
7. To determine surface heat transfer coefficient for a vertical tube losing heat by free convection.
8. To determine surface heat transfer coefficient for pipe losing heat by forced convection.
9. Determination of overall heat transfer coefficients for unsteady state heating process
10. To determine the value of Stefan Boltzmann constant for radiation heat transfer.
11. To determine LMTD, rate of heat transfer and effectiveness by NTU method for parallel flow heat exchanger.
12. To determine LMTD, rate of heat transfer and effectiveness by NTU method for counter current flow heat exchanger.
13. To determine the moisture diffusivity and activation energy for different geometries of food materials having rectangular/cubical geometry.
14. To determine the moisture diffusivity and activation energy for different geometries of food materials having cylindrical geometry.
15. To determine the moisture diffusivity and activation energy for different geometries of food materials having spherical geometry.
16. To study the behavior of boiling curve.

Title of the course : Unit Operations
Subject Code : FT-513
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Definition and application in food processing.	1
	Size reduction	Theory of communition, Ritinger's law, Kick's law, Bond's law and their applications in calculation of energy required in grinding, Crushing efficiency, Size reduction equipment used in food industry.	8
	Sieving	Separation based on size, Effectiveness of screens, Types of screens, Factors affecting the sieving process, Fineness modules and particle size distribution	5
	Mixing	Theoretical aspects of solid mixing. Mixing index, rate of mixing, Theory of liquid mixing, Equipment for liquid and solid mixing.	6
2	**Leaching and extraction**	Concentration, Gas – Liquid equilibria, Solid – Liquid equilibria, Extraction-Solid Liquid extraction, Liquid-Liquid extraction, stage equilibrium extraction. Super critical fluid extraction, Application-extraction of fatty acid, Essential oils.	8
	Distillation	Liquid vapor equilibrium, distillation of binary mixtures, simple distillation, flash distillation, steam distillation. Crystallization-rate of crystallization, crystallization equilibrium.	8
	Filtration	Theoretical aspects, Fundamental equation for filtration, Filtration equipment.	8
	Sedimentation and centrifugal separation	Theory, Gravitational sedimentation of particles in liquids and gases, Sedimentation equipment. Basic equation, centrifugal clarification, Equipments.	6

Total=50

Recommended books:

Author	Title	Publishers
P. Fellows	Food Processing Technology	Woodhead Pub
R. L. Earle	Unit Operations in Food Processing	

FT-513 (P)
Unit Operations Lab

1. Study of various equipments in Unit Operation Lab
2. Determination of critical speed of ball mill
3. Determination of power requirement of a given grinding equipment
4. Determination of the effect of hammer mill speed and screen size on particle size of the ground material
5. Determination of effectiveness of screen
6. Determination of fineness modulus of a ground sample
7. Effect of mixing time on the mixing index of solid mixing
8. Calculation of power requirement of a mixer
9. Dismantling and Assembly of horizontal filter press
10. Constructional features of rotary drum vacuum filter
11. Determination of factitious thickness of filter medium
12. Dismantling and Assembly of disc bowl centrifuge
13. Effect of speed of centrifuge on the composition and yield of cream
14. Determination of sedimentation rate of a slurry

Title of the course : Numerical Analysis
Subject Code : AM - 521
Weekly load : 5 Hrs. **LTP 3-0-2**
Credit : 4 (Lecture 3; Tutorial 0; Practical 1)

Unit	Main Topic	Detailed contents	Lectures
1	**Errors**	Errors in arithmetic operations and functions. Round-off error, truncation error. Absolute error. Relative error. Percentage error. Principles of equal effect. Significant digits.	4
	Roots of equations	Intermediate value property. Bisection method. Method of false position. Secant Method. Newton-Raphson method. Iteration method. Convergence of these methods.	6
	Solution of linear equations	Gauss Elimination method (with and without partial pivoting). Gauss-Seidel, Jacobi's methods. Triangularization method.	5
	Eigen value	Rayleigh's power method for finding dominant eigen value.	4
	Finite differences	Finite differences-forward, backward and central differences. Shift and averaging operators.	4
2	**Interpolation**	Newton's forward, backward and divided difference interpolation formulae. Lagrange's formula. Gauss forward and backward difference interpolation formulae. Spline interpolation–quadratic and cubic.	7
	Numerical differentiation and integration	Numerical differentiation using Newton's forward and backward difference formulae. Numerical integration – Trapezoidal rule, Simpson's one third and three-eighth rules. Romberg's integration. Error in integration.	8
	Numerical solution of ODEs	Taylor series method. Picard's method. Euler method. Modified Euler's method. Runge- Kutta methods (upto fourth order) for solution of ODE of first order.	7

Total=45

Recommended Books:

Author	Title	Publisher
S.S. Sastry	Introductory Method of Numerical Analysis	PHI.
Gerald Wheatley	Applied Numerical Analysis	Pearsons Education
M.K. Jain, S.R.K. Iyengar and R.K. Jain	Numerical Methods for Sc. and Engg. Computation	PHI.
J.H. Mathew	Numerical Methods for Maths, Science and Engg.	PHI.

AM-521 (P)
Numerical Analysis Lab

1. Finding roots of the equation $f(x) = 0$ using
   i) Bisection Method ii) Secant Method iii) Method of false position
2. Finding roots of the equation $f(x) = 0$ using
   i) Iterative Method ii) Newton - Raphson's Method
3. To check consistency and finding Solution of a system of linear algebraic equations using
   i) Gauss elimination Method ii) Gauss - Seidal Method iii) Jacobi Method
4. Solution of a system of linear equations by triangularization method.
5. Finding dominating Eigen value and Eigen vector using Rayleigh's power Method.
6. Interpolation using
   i) Newton's forward difference formula ii) Newton's backward difference formula
7. Interpolation using
   i) Newton's divided difference formula ii) Lagrange's interpolation formula
8. Interpolation using
   i) Gauss's forward formula ii) Gauss's backward difference formula
9. Interpolation using Splines
   i) Linear ii) Quadratic iii) Cubic
10. Numerical differentiation using
    i) Newton's forward interpolation formula ii) Newton's backward interpolation formula
11. Numerical Integration using
    i) Trapezoidal rule ii) Simpson's $1/3^{rd}$ rule
    iii) Simpson's $3/8^{th}$ rule iv) Romberg's rule
12. Solution of Ist order ordinary differential equations using
    i) Taylor's series method ii) Picard's method
    iii)Euler's method iv)Euler's modified method
13. Solution of Ist order ordinary differential equations using
    i) Runge-Kutta method of III^{rd} order ii) Runge-Kutta method of IV^{th} order

Title of the course : Human values and professional ethics
Subject Code : MC-521
Weekly load : 01 Hr **LTP** 1-0-0
Credit : 0

Unit	Main Topic	Detailed contents	Lectures
1	**Values and Self Development**	Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non moral valuation, Standards and principles, Value judgments. Importance of cultivation of values, Sense of duty, Devotion, Self reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.	4
	Personality and Behaviour Development	Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self destructive habits, Association and cooperation, Doing best, Saving nature.	4
2	**Character and Competence**	Science vs. God, Holy books vs. blind faith, Self management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self control, Honesty, Studying effectively.	3
	Human Rights	Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.	2
	Competence in professional ethics	Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems	3

Total=16

Recommended Books:

Author	Title	Publisher
S. K. Chakraborty	Values and Ethics for Organizations Theory and Practice	Oxford University Press, New Delhi.
S.K. Kapoor	Human rights under International Law and Indian Law	Prentice Hall of India, New Delhi
D.D. Basu, Indian Constitution		Oxford University Press, New Delhi.
W.K. Frankena	Ethics	Prentice Hall of India, New Delhi
R. R. Gaur, R. Sangal, G. P. Bagaria	A Foundation Course in Value Education	
M Govindrajran, S Natrajan, V.S. Senthil Kumar	Engineering Ethics(including Human Values); Eastern Economy Edition	Prentice Hall of India Ltd

Title of the course : Food Engineering
Subject Code : FT-521
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Units and Conversion**	Fundamental and derived units; Systems of units, Conversions from other systems to SI system. Numerical problem	3
	Material Balance	Introduction to material balance, Numerical problems on material balance related to food processing.	5
	Energy Balance	Introduction to energy balance, Steam properties, Use of Steam tables, Numerical problems on material and energy balance related to food processing	5
	Thermal Processing	Target microorganism for thermal processing, Concept of D, F and Z value, Microbial inactivation; Derivation and application of equation for determination of thermal process time for cans, evaluation of thermal process time for batch sterilization by graphical method; calculation of process time for continuous sterilization of liquid foods; factors affecting rate of heat penetration; effect of can size on sterility requirement; related numerical problems, concept of activation energy, concept of Q value, Application of Q rule for Estimation of shelf life, amount of change and Accelerated Storage Study.	7
2	**Psychrometry**	Properties of air- water vapour mixture, psychometric chart, Humidification and dehumidification operations, Application of Psychrometry to drying; related numerical problems.	4
	Drying	Principles of drying and dehydration, water activity, sorption and desorption isotherms, rates of drying: constant and falling rate periods during convective drying, drying rate constant; capillary flow and diffusion in falling rate period; determination of moisture diffusivity for various geometries of food materials; freeze drying and spray drying; calculations of freeze drying and spray drying times; related numerical problems	5
	Evaporation	Boiling point elevation, Duhring rule, basic principles of evaporators; capacity and economy of evaporator; multiple effect evaporator: operation and various feeding systems, calculation of heat transfer area in single and multiple effect evaporators; Thermal vapour recompression and Mechanical vapour recompression system to improve evaporator economy; related numerical problems	5
	Food Freezing	Basic concepts, theories of crystallization; Depression in freezing point, Planks equation and other modified equations for prediction of freezing time, freezing time calculations for a product having uniform temperature (negligible internal resistance), different types of freezers.	5

Total=39

Recommended books:

Author	Title	Publisher
R.T. Toledo	Fundamentals of food process Engg	CBS
Brennan and Cowell	Food Engineering Operations	Applied Science
Heldman and Singh	Food Process Engineering	Academic Press
Smith, P G	Intro to Food Process Engg	Springer
Geankoplis	Transport Process & Unit operations	PHI

FT-521 (P)
Food Engineering Lab

1. Calculation of thermal process time by formula method
2. Calculation of thermal process time by graphical method
3. Determination of steam properties using Mollier diagram
4. Determination of steam properties using steam tables
5. Study of different types of evaporators
6. Determination of relative humidity using Psychometric chart
7. Study the drying characteristics of a food material during convective dehydration
8. Determination of moisture diffusivity of a food material during dehydration.
9. Determination of activation energy for dehydration of a food sample.
10. Comparison of freeze drying time determined by Experiment and from modified Plank's equation
11. Determination of freezing point depression of a food material.
12. Study of freezing curve for a food material.
13. Determination of the freezing time for a given food sample using unsteady state heat transfer charts
14. Study of different types of heat exchangers

Title of the course : Biotechnology
Subject Code : FT-522
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	History, scope and present status of biotechnology in India in relation to food technology and its general applications.	5
	Microbial production of products	Single cell proteins, organic acids (lactic and citric acid), antibiotics and vitamins with special reference to substrates and optimum conditions for growth of microorganism.	6
	Enzyme technology	Sources of enzymes, advantages of microbial enzymes, extraction and purification of enzymes, applications of enzymes in food industry.	6
	Tissue culture technology	Definition, cellular totipotency, somatic hybridization, protoplast fusion, applications.	5
2	**Mutation and repair mechanisms**	Mutation, mutagens, types of mutations, repair mechanisms, photo-reactivation repair and excision repair, applications of mutations in strain improvement.	6
	Techniques of genetic engineering	Gene cloning procedures-general outline, recombinant DNA technology, different vectors involved plasmids, cosmids & phagemids, transfer of recombinant molecules into host organisms, genetically modified foods.	8
	Environmental biotechnology	Biochemical oxygen demand, chemical oxygen demand, aerobic and anaerobic methods of treatment of food industry wastes with special reference to methanogenesis. BIS standards for safer disposal of industrial waste water.	6

Total=42

Recommended books:

Author	Title	Publisher
B.D. Singh	Biotechnology	
P.K. Gupta	Biotechnology	
S.S. Marwaha	Food Processing: Biotechnological Applications	Asiatech
P.S. Panesar & SS Marwaha	Biotechnology in Agriculture and Food Processing	

FT-522 (P)
Biotechnology Lab

1. To study different equipments related to Biotechnology.
2. Preparation of various media for culturing of microbes.
3. To enumerate the cells in the given sample by using haemocytometer.
4. To study the effect of pH on the growth of microorganisms.
5. To study the %age viability of the inoculum.
6. To study the disruption of cells using mechanical method.
7. To study the production of ethanol by bacterial fermentation.
8. To study the production of ethanol by yeast fermentation.
9. To study the production of an enzyme by given organism.
10. To study the production of ethanol by bacterial fermentation
11. Microbial production of citric acid.
12. Microbial production of lactic acid.
13. To determine Biochemical Oxygen Demand of a given sample
14. To determine Chemical Oxygen Demand of a given sample.
15. Demonstration of mutagenesis using UV radiations method.

Title of the course : Dairy Engineering
Subject Code : FT-523
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Status of dairy industries in India, Engineering properties of milk and milk products and their significance in equipment design.	2
	Composition of milk	Composition, factors affecting composition of milk, Effect of milk on metals	4
	Homogenization of milk	Principle of homogenization, Classification, single stage and two stage homogenizers, power requirement, care and maintenance of homogenizers, application of homogenization in dairy industry.	6
	Thermal processing of milk	Pasteurization: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Care and maintenance of pasteurizers. UHT method: Direct and indirect heating system. Equipments for sterilization in the package (Batch and continuous sterilizers).	6
2	**Concentration of milk**	Concentration of milk and machineries, heat and mass balance in single and multiple effect evaporator, types of evaporators and their performances characteristics and selection criteria	6
	Drying and dehydration of milk	Drying theories, estimation of drying rates and drying time, drying equipment (spray drier, drum drier).	6
	Freezing	Types of ice-cream and ingredients, Technology of ice-cream preparation: Preparation of ice-cream mix, partial freezing, final freezing and hardening, freezing methods and equipment, freezing time calculations.	8
	Cleaning and sanitation	Selection and use of dairy cleaners and sanitizers, washing equipment, working and maintenance of can washers, steam sterilization of cans, clean in place system, factors affecting, and washing operation.	7

Total=45

Recommended books:

Author	Title	Publishers
Su Kumar De	Outlines of dairy technology	Oxford
Walstra	Dairy Technology	
Spreer	Milk and Dairy Product Technology	
Eckles, Comb and Macy	Milk and milk products	
Kessler	Food Engineering and Dairy technology	
Farral	Engineering of Food and Dairy products	

FT-523 (P)

Dairy Engineering Lab

1. To analyze milk sample for following parameters.
   i) %Acidity & pH ii) Specific gravity iii) Total solids & SNF iv) Fat v) COB and Alcohol.
2. To study the various types of pumps and their performance.
3. To study the different parts of a homogenizer.
4. To study the effect of temperature and pressure on homogenization.
5. Lactose determination in milk by Lane & Eynon method.
6. To analyze milk powder sample for various parameters.
7. To analyze condensed milk for various parameter.
8. To analyze butter sample.
9. Preparation of paneer.
10. Preparation of ice-cream.
11. Preparation of softy (soft-service-ice-cream).
12. To evaluate quality attributes of softy.
13. To examine quality parameters of paneer
14. Maintenance of cream separator and functions of various key parts

Title of the course : Fluid Flow Operations and Rheology
Subject Code : FT-524
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction to fluid flow**	Physical properties of fluids like mass density, specific gravity, viscosity, pressure, factors affecting the rheological parameters; fluid pressure and its measurement; manometers, simple manometers, differential manometers; concept of Reynolds's number.	6
	Fluid flow measurement	Derivation of continuity equation; different types of energies of a liquid in motion; derivation of Bernoulli's equation; practical applications of Bernoulli's equation like venturimeter, orifice meter, pitot tube, rotameter. Numerical problems.	6
	Types of fluids	Newtonian and non-Newtonian fluids, Concept of apparent viscosity. Thixotropic and antithixotropic fluids; Viscous (Power law fluids); Plastic fluids, Viscoelastic fluids. Important models describing the time dependent and time independent behavior of fluids.	4
	Laminar viscous fluid flow	Flow of viscous fluid through circular pipe, Coefficient of friction; head loss due to Friction in pipes; head loss due to sudden enlargement, contraction, vena contracta, entrance and exit losses; Stokes law (laminar flow around a sphere); laminar flow through porous media; pressure drop in flow through porous media.	6
2	**Pumps**	Types of pumps and classification criteria, Theory and working of centrifugal pump, reciprocating pumps, external gear pump (rotary pump), Lobe pump, Vane pump etc.	3
	Viscometery	Theory and working of capillary tube viscometer for Newtonian and non-Newtonian fluids; Falling sphere resistance method; Rotational viscometer; Cone and plate type viscometer; Circular disc viscometer.	5
	Rheology of Viscoelastic Fluids	Introduction to viscoelastic materials, stress relaxation; creep (retarded deformation); static or quasi-static or transient methods for viscoelastic material; Maxwell model, Kelvin- voigt model and Burger model; dynamic (varying stress or strain) or oscillatory measurements methods; Textural Profile Analysis.	7

	Fluidization	Physical properties of particles like size, shape, sphericity, porosity, superficial and interstitial velocity, hydraulic radius, equivalent diameter etc. Mechanism of fluidization, characteristics of gas – solid fluidized systems, Fanning friction factor for porous media; ; minimum porosity, bed weight, pressure drop in fluidized bed, theory and analysis of fluidization process; particulate fluidization; aggregative (or bubbling) fluidization; principle of fluidized bed drying equipment; pneumatic conveyers. Numerical problems.	7

Total=44

Recommended Books:

Author	**Title**	**Publisher**
McCabe & Smith	Unit Operations in Chemical Engineering,	McGraw Hill
V. Gupta & S.K. Gupta	Fluid Mechanics & Application,	
G. S. Sawhney	Fundamentals of Fluid Mechanics	
R K Bansal	A Text book of Fluid Mechanics and Hydraulic machines.	
Arora K. R	Fluid Mechanics Hydraulic and Hydraulic machines	
Ghosal, S K, Sanyal S K and Datta S	Introduction to Chemical Engineering,	
Ibraz Albert and Barbosa-Canovas G V	Unit Operations in Food engineering	
SC Rao & C Guha	Transport Phenomena	

FT-524 (P)
Fluid Flow Operations and Rheology Lab

1. To calculate the average flow velocity at different sections of a tube having variable area.
2. Estimation of pressure by use of manometer.
3. Determination of fluid flow behavior by Reynolds number apparatus
4. Determination of fluid flow velocity by venturimeter
5. Determination of fluid flow velocity by orifice meter
6. Verification of Bernoulli equation
7. Effect of temperature on the viscosity of a fluid food.
8. Determination of terminal/fluidization velocity for fluidization of particles
9. Study of various types of pumps.
10. To calculate the terminal velocity for fluidization.
11. Determination of viscosity by capillary viscometer.
12. Determination of viscosity by Ostwald viscometer
13. Determination of viscosity by rotational viscometer
14. TPA study of a biomaterial.

Title of course : Biochemical Engineering
Subject Code : FT-611
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Introduction to biochemical engineering, its scope and area covered, Microbiological and biochemical aspects related to biological processes	2
	Media sterilization	Medium formulation, Thermal sterilization, Sterilization by filtration, Design criteria and design equations for sterilization process, Temperature-time profile and design calculations, Methods of air sterilization, Interception, diffusion and combined mechanism	6
	Microbial growth and death kinetics	Microbial growth kinetics under batch and continuous process, Thermal death kinetics of microorganism, measuring and monitoring growth processes, influence of temperature on specific growth and death rates, relationship between growth and substrate utilization.	12
2	**Enzyme kinetics**	Concepts of free energy and activation energy, simple enzyme reaction kinetics, complex enzyme kinetics, Michaelis-Menten equation, Briggs–Halden approach, evaluation of parameters, enzyme inhibition (competitive and non-competitive), Methods of enzyme immobilization.	12
	Bioreactor & its control system	Bioreactor design and analysis in view of microbial reaction process, operation of batch and continuous fermentation system, oxygen supply and demand in microbial processes, mass transfer resistances, critical value of oxygen concentration and oxygen uptake rate, aeration system in fermenter, types and design of sparger.	12
			Total=42

Recommended Books:

Author	Title	Publisher
Aiba, S, Humphrey, A.E. and Millis, N.	Biochemical Engineering	Academic press
Bailey, J.E and Ollis, D.F.	Biochemical Engineering Fundamentals	McGraw Hill, NY
James M. Lee	Biochemical Engineering	Prentice Hall, NJ
Stanbury, P.F Whitaker, W and Hall, S.J	Principles of Fermentation Technology	Reed Elsevier Pvt Ltd, New Delhi

FT-611 (P)

Biochemical Engineering Lab

1. To acquaint with various equipments and their principle commonly used in biochemical engineering.
2. Growth kinetic study of *Aspergillus niger* using incubator and incubator shaker.
3. To study the effect of temperature and pH on enzyme activity.
4. To determine reaction rate and Michaelis Menten equation for enzyme.
5. Extraction and characterization of enzymes.
6. Immobilization of enzyme by using $cacl_2$.
7. To study the effect of substrate on enzyme production.
8. Filtration and centrifugation of enzyme for purification.
9. Cell homogenization and extracellular enzyme content.
10. Temperature effect on denaturation of enzyme.

Title of the course : Technology of Cereal Processing
Subject Code : FT-612
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	General introduction to cereals and pulses; Production and utilization trends of various cereals and pulses; Grain classification, structure and composition; Drying, grading and storage of cereal and pulses.	4
	Pulses	Anti-nutritional factors and methods of inactivation; pre-treatments; Traditional and modern milling methods and equipment involved; By-products of pulse milling and their utilization.	6
	Wheat	Milling of wheat; Factors affecting yield and quality of flour; Flour treatments; Air-classification; Quality assessment of grain and flour; Concept of composite flour; dough Rheology; Wheat starch processing; Technology of Pasta products.	10
2	**Rice**	Rice milling; milling machines; effect of different factors on milling yield and rice quality; Parboiling of paddy-different methods of parboiling; Curing and aging of rice; Rice starch processing; Milled rice products and by-products (rice gluten and rice bran oil and de-oiled rice bran).	10
	Corn	Wet and dry milling of corn; Comparison of conventional and modern process for wet milling processes; Milling machines; Corn flakes, syrups, extraction of starch, starch derivatives, starch modification.	10
	Barley and Millets	Milling of barley and millets, malting of barley, utilization of barley and millet products.	5

Total =45

Recommended books:

Author	Title	Publisher
Dendy & Dobraszczyk	Cereal and cereal products	Aspen.
Hoseney RS.	Principle of cereal science and technology	AACC.
Kent NL.	Technology of cereal	Pergamon
Kulp K & Ponte GJ	Handbook of cereal science and technology	Marcel Dekker
A. Chakraverty	Handbook of post harvest technology	Marcel Dekker

FT-612 (P)
Technology of Cereal processing Lab

1. Determination of acid insoluble ash of different cereal flour.
2. Determination of dry and wet gluten of a given flour sample.
3. Determination of sedimentation value.
4. Particle size index determination by sieve analysis.
5. Determination of Hagberg's falling number.
6. Determination of maltose value in flour sample.
7. Determination of alcoholic acidity of flour.
8. Preparation of bakery products.
9. Determination of flour water absorption and the dough properties by Alveo-consistograph.
10. Determination of hectolitre weight and 1000 Kernel weight.
11. Comparative studies of flour milled in different mills.
12. Preparation of noodles and its quality evaluation.
13. Determination of dehusking efficiency and breakage in dehusking of rice
14. Determination of dehusking efficiency and breakage in dehusking of pulse.
15. Determination of percentage impurities in grain by aspirator and seed blower.
16. Visit to rice mills and bakery units.

Title of the course : Technology of Animal Products
Subject Code : FT-613
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Structure and Composition of Muscle and associated tissue**	Muscle tissue, skeletal muscle, skeletal muscle fiber, myofibrils, myofilaments, smooth muscle, cardiac muscle, epithelial tissue, nervous tissue. Connective tissues. Connective tissue proper, adipose tissue. Muscle bundles and associated connective tissues. Muscle and fiber types. Chemical composition of skeletal muscle.	8
	Conversion of muscle to meat	Homeostasis, Exsanguination, circulatory failure to muscle, postmortem pH decline, rigor mortis, Enzymatic degradation.	7
	Properties of fresh meat	Water holding capacity, chemical basis of water holding capacity, color, pigments. Chemical state of pigments.	6
2	**Principles of meat processing**	Curing, meat curing ingredients, methods for incorporation of cure ingredients, chemistry of cured color, Smoking of meat, comminution, blending and emulsification. Technology of sausages.	7
	Beef, mutton and pork	Slaughtering of cattle, sheep and pig. By products of meat industry.	4
	Poultry dressing and egg processing	Stunning, bleeding, scalding, evisceration, packaging and storage. Structure, composition and nutritive value of an egg. Functional properties of egg constituents, Interior quality of eggs and its preservation, Egg products.	6
	Fish processing	Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates. By products of fish processing industry.	8

Total=46

Recommended books:

Author	Title	Publisher
J.C. Forest, E.D. Aberle, H.B. Hedrick	Principles of meat science	W.H. Freeman and company
B. Panda	Principle of meat science	ICAR
Robert L. Henrickson	Meat, poultry and seafood technology	Prentice Hall New Jersey

FT-613 (P)
Technology of Animal Products Lab

1. To study the effect of low and high oxygen atmosphere on meat colour.
2. To study the chemistry of myoglobin as it relates to the color of the molecule.
3. To understand and compare the action of two meat tenderizing enzymes by applying the technique of electrophoresis.
4. To study the structure of the muscle under compound microscope.
5. Perform the slaughtering of the poultry birds.
6. Identification of different internal organs of poultry birds and their utilization for product preparation.
7. Dressing of Fish.
8. Determination of total volatile acids in fish,
9. Determination of buffering capacity of fish muscle.
10. Rapid estimation of hypoxanthine concentration in chill stored fish.
11. Determination of glycine in fish muscle.
12. Determination of protein fractions in fresh fish.
13. Cut out test for canned fishery products.
14. Determination of glycogen in fish muscle.
15. Industrial visit to meat industry.

Title of the course : Food Analysis and Quality Control
Subject Code : FT-614
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Quality control and its importance; functions of quality control department and quality control laboratories	3
	Colour	Importance and need of colour determination; methods of colour determination with Spectrophotometer, Colorimeter, Hunter Colour lab, CIE system, Lovibond Tintometer, Munsell colour and colour difference meter, Disc colorometry and their applications	9
	Kinesthetics and Texture	Food texture; physical characteristics of food; working of texture measuring instruments such as Texture Analyzer, Instron Universal Testing machine, Fruit pressure tester, Puncture tester, Succulometer, Tenderometer, Texturometer, Maturometer and Fibrometer; Texture Profile Analysis (TPA)	6
2	**Non-destructive methods**	Near Infrared Spectroscopy (NIR); Nuclear Magnetic Resonance (NMR) and its application; Ultrasonic equipments; conductivity and resistivity meters	9
	Chromatography	Principle and working of Gas chromatography (GC); High Pressure Liquid Chromatography (HPLC); types of detectors used in GC and HPLC; Thin layer chromatography (TLC), chromatographic methods applied as quality control.	8
	Food Safety and Regulations	Food Safety and Standards Act (2006); Codex Alimentarius; ISO series; Good Manufacturing Practices (GMP); Genetically Modified Foods (GMF)	8

Total=43

Recommended books:

Author	Title	Publisher
Ronald S	Pearson's Composition and Analysis of foods	Addison & Wesley
Ranganna	Handbook of Analysis of Fruit and Vegetable and their Products	Tata Mc Graw-Hill
Pomeranz and Meloan	Food Analysis	

FT-614 (P)
Food Analysis and Quality Control Lab

1. Determination of acid soluble, water soluble, insoluble acid, ash fractions.
2. Determination of carotenoids.
3. Determination of colour value by using different methods
4. Determination of ascorbic acid by titrimetric and photometric methods.
5. Determination of lycopene content of tomato & its products.
6. Determination of iron, phosphorous & sulphur in foods.
7. Determination of pigment in food sample.
8. Determination of lead, arsenic, and tin content in food.
9. Analysis of canned and processed products available in the market
10. Cut out analysis of canned product.
11. Estimation of Vit A, D in desi ghee
12. Determination of viscosity liquid food
13. Determination of FFA and Acid value of given sample
14. Analysis of ice cream for fat, acidity, total solids, foreign fat

Title of the course : Food Storage Engineering
Subject Code : FT-615
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Purpose and justification of storage of perishable and non-perishable foods, factors influencing shelf life of food materials, Brief account of engineering properties of biological materials important in design of handling and storage equipments	4
	Storage requirements	Storage environment and its interaction with stored product; temperature and moisture migration;, storage practices (including fumigation and aeration of stored product); design of aeration systems.	8
	Mechanical Handling equipments	Design of handling equipments like bucket elevators, belt, screw and pneumatic conveyors, and fans	10
2	**Storage structures for non perishables**	Grain pressure theories- Rankine and Airy theory: Design of bulk storage structures like bins and silos; Design of bag storage structures such as cover and plinth (CAP) and warehouses	10
	Storage structures for perishables	Design aspects of ventilated, cold, modified and controlled atmosphere storage systems.	8
	Management practices	Labelling, record keeping and management of godowns, silos and cold storages; maintenance of buildings and equipments; sanitary conditions in storages	4

Total= 44

Recommended books:

Author	Title	Publisher
Bala, B. K.	Drying and storage of cereal Grains	Oxford and IBH
Sinha and Muir	Grain storage-Part of a System	AVI
Volkind and Roslov Amerind	Modern Potato and Vegetable storage	Amerind
Multon, J.L	Preservation and storage of grains, seeds and their by products	CBS
Singh and Sahay	Unit operations in Agril processing	Vikas Pub

FT-615 (P)
Food Storage Engineering Lab

1. Effect of moisture content on Bulk density, True density and porosity of grains
2. To determine the shape characteristics of various food samples
3. To determine static angle of repose of a food grain sample
4. To determine dynamic angle of repose of a food grain sample
5. To determine coefficient of static friction of food grains
6. To study the effect of various surfaces on external friction
7. To study the change in α-amylase activity of stored flour using falling number apparatus
8. To determine equilibrium moisture content (EMC) of the food product using static method
9. To determine equilibrium moisture content (EMC) of the food product using dynamic method
10. To determine water activity of given food material
11. To determine pressure over different depth in a silo using Janssen equation
12. To determine the effect of various parameters (temperature, moisture etc.) on germination capacity of food grains
13. To analyze stored food material for various impurities : insect parts, rodent excreta, bird droppings, infested grains
14. Visit to cold storage, warehouses.
15. Study various grain handling equipments, conveyors, elevators etc

Title of the course : Technology of Fruits and Vegetable Products
Subject Code : FT-616
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Status, Post harvest losses, Composition of major fruits and vegetables. Post harvest field operations, preservation treatments for freshly harvested fruits and vegetables, Packaging of whole fruits and vegetables for internal and export markets. General methods of preservation of whole fruits/Vegetables.	7
	Physiology	Respiration, transpiration, ripening, senescence, climacteric and non-climacteric fruits, factor effecting composition and quality of fruits and vegetables. Ripening index of different fruits and vegetables.	5
	Processing of fresh fruits and vegetables	Cleaning methods, sorting, grading, peeling and blanching. Extraction of fruits juices. Fruit juice concentrates. Fruit powders. Fruit juice aroma recovery and its importance. Definition and preparation of fruits beverages.	6
2	**Preservation with sugar**	Definition, constituents, pectin and related compounds, preparation of apple, plum, pineapple and mix fruit jam; preparation of guava jelly, marmalade, theory of jell formation, failure and remedies in jam and jelly making. Definition and preparation of preserves and candied fruits,	8
	Canning of fruits and vegetables	General comparison of fruits and vegetables canning. Containers used in canning of fruits and vegetables, types of cans, Base Box, lacquering Precautions in Canning operations. methods and equipment for processing, calculating TDT, Importance of blanching operations. Batch and continuous blanching. Hot water and Steam blanching. Different steps involved in canning of fruits; preparation of syrups and brines, testing of brines, processing methods and equipment, spoilage of canned foods, discolorations, corrosion.	7
	Pickles tomato products	Definition, manufacturing process, preparation of chutney, preparation of pickles. Manufacturing process of tomato based products like tomato juice, soup, puree, sauce, ketchup and paste; spoilage of products and their preventive measure.	7
	Freezing and dehydration	Pre-treatments of fruits and vegetables for freezing and dehydration; Individual Quick Freezing (IQF); dehydrated products.	5

Total=45

Recommended books:

Author	Title	Publisher
Girdhari lal and Sidappa	Preservation of Fruits and Vegetable	ICAR
Shrivastava and Kunal	Fruits and vegetable preservations	
N Shakuntala manay	Food facts and principles	
Luh and Wudruf	Commercial Fruit Processing	AVI, NY
Wills, Lee	Post-Harvest Physiology & Handling of Fruits & Vegetables	
Ranganna	Analysis of Fruits and Vegetables	TMH
Cruess	Commercial Fruit and vegetable products	

FT-616 (P)
Technology of Fruits and Vegetable Products Lab

1. Anatomy and structure of fruits and vegetables
2. Quality evaluation of fruits and vegetables
3. Quantitative analysis of cut fruits and vegetable yield
4. Effects of pre-treatment on quality of cut fruits and vegetables
5. Determination of blanching time
6. Evaluation of peeling effectiveness
7. Preparation of fruit and synthetic beverages
8. End point determination in preparation of high sugar product (Mixed fruit jam)
9. Effect of pre-treatment and process variables on quality of preserve/candied fruits
10. Preparation of pickle using various techniques
11. Comparison of juice/pulp extraction methods on quality and yield of tomato pulp
12. Preparation of Tomato ketchup/Tomato soup
13. Canning and cut out analysis of fruit and vegetable
14. Dehydration and rehydration of common available vegetable
15. Freezing of papaya cubes in syrup
16. Visit to fruit and vegetable processing Industry

Title of the course : Post Harvest Engineering
Subject Code : FT-621 A
Weekly load : 5 **LTP** 3-2-0
Credit : 4 (Lecture 3; Tutorial 2; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction to Postharvest Food Systems**	Internal and External Factors Affecting Quality of Fresh Produce, Grain Type and End-use Quality Determining Factors, Fruit and Vegetable Handling Systems	11
	Grain Post-Harvest Storage, Drying, Handling and Milling	Design of Aeration System, Design of Storage Facilities, Drying theory and Design, Design of Handling System, Milling Technology	11
2	**Handling and Storage of Horticultural Crops**	Losses Due to Physiological Changes, Mechanical Damage, Pests and Diseases, Quality Assessment and Conservation Techniques	6
	Design and Operation of Cooling Systems for Fresh Produce	Refrigeration System Design, Controlled Atmosphere and Modified Atmosphere Storage	6
	Pre-treatment and Handling Operation for Fruits and Vegetables	Effect of Pre-Cooling on Produce Quality and Design Parameters, Hot Water and Vapor Treatment for Disease and Insect Control, Grading, Waxing and Packaging, Packing House design	10

Total=44

Recommended books:

Author	Title	Publisher
H. W. Von Loesecke	Drying and Dehydration of Foods	
S. T. Beckett	Physico-Chemical Aspect of Food Processing	Blackie Academic and Professional
Marcel Dekker	Handbook of Cereal Science and Technology	Woodhead Publishing
Brooker, D.B.; Bakker-Arkema, F.W.; Hall, C.W	Drying and storage of grains and oilseeds	
R. Wills, B. McGlasson, D. Graham, and D. Joyce	Postharvest-An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals	AVI Publishing company
	Produce Handling Packaging and Distribution	
R. L. Shewfelt and S. E. Prussia	Postharvest Handling: A System Approach	
O. J. Loewer, T. C. Bridges and R. A. Bucklin	On-farm Drying and Storage Systems	Academic Publishers
Henderson, S.M., R.L. Perry, and J.H. Young	Principles of Process Engineering	AVI Publishing company
Kader, A.A. (editor). 2002.	Postharvest Technology of Horticultural Crops (3rd edition)	AVI Publishing company
Mujumdar, A.S	Handbook of Industrial Drying 3rd ed	

Title of the course : Statistical Quality Control
Subject Code : FT-621 B
Weekly load : 5 **LTP** 3-2-0
Credit : 4 (Lecture 3; Tutorial 2; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	The meaning of quality and quality improvement, Statistical methods for quality control and improvement.	2
	Food Quality System	The link between quality and productivity, Quality costs, Legal aspects of quality, implementing quality improvement.	3
	Control Charts for Variables	Statistical basis of the charts, Development and use of x and R, Charts based on standard values, Interpretation of x and *R* charts, The effect of non-normality on *x* and *R* charts, Construction and operation of *x* and *S* charts, The *x* and *S* control charts with variable sample size, Application of variables control charts	5
	Process Capability Analysis (PCA)	PCA using probability plot, Process capability ratios, PCA using a control chart, PCA using designed experiments	6
	Control Charts for Attributes	The control chart for fraction non-confirming, Control charts for non-conformities (defects), Procedures with constant sample size, Procedures with variable sample size, The operating-characteristic function	5
2	**Sampling**	Population and sample proportions, Sampling techniques, Sampling and non-sampling errors, Shape of the sampling distribution of *x and p,* Applications of the sampling distribution	4
	Descriptive statistics	Methods to measure central tendency (mean, median and mode) and dispersion (mean deviation, standard deviation and variance),	5
	Inferential statistics	Hypothesis tests, Estimation and hypothesis testing: two populations, Chi-square tests, Analysis of Variance, Simple linear regression, Non-parametric methods	3
	Design of Experiments and Process Optimization	Guidelines for designing experiments, Factorial experiments, the 2^k factorial design, Fractional replication of the 2^k design, Response surface methods and designs.	6
	Six Sigma	Introduction, Six-sigma control chart, Six-sigma quality performance	3

Total=42

Recommended books:

Author	Title	Publisher
D.C. Montgomery	Introduction to statistical quality control	Brookes Cole Publishing
P.S. Mann	Introductory Statistics	John Wiley and Sons, Canada
Jerome D. Braverman	Fundamentals of Statistical quality control	

Title of the course : Engineering Economics and Entrepreneurship
Subject : HU-621
Weekly Load : 3 **LTP** 3- 0 -0
Credit : 3 (Lecture 3)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Engineers and Economics, Utility of its study, Managerial Economics, Nature and scope, basic terms and concept of economics like goods, kinds of goods.	2
	Theory of Demand and Supply	Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, The meaning of Supply, Supply function, Law of supply- Explanation of law of supply.	8
	Environment Analysis	Concept of National income- GDP, GNP, Monetary policy, Fiscal Policy.	5
	Entrepreneurship-Enterprise	Conceptual issues, Entrepreneurship vs. Management, Concept of Social Entrepreneurship and Women Entrepreneurship, Roles and functions of engineer in relation to the enterprise and in relation to the economy.	7
	Business Excellence	Role of creativity and innovation and business research, Sources of business idea, TQM, Six Sigma	2
2	**The process of setting up a small business**	Preliminary screening and aspects of the detailed study of the feasibility of the business idea , Preparation of Project Report and Report on Experiential Learning of successful and unsuccessful entrepreneurs..	4
	Communication skills	Introduction, process of communication, barriers to communication, Removal of barriers, channels of communication, Verbal and non-verbal communication.	3
	Issues in small business marketing.	The concept and application of product life cycle ,Advertising and publicity, sales and distribution management, National, state level and grass-root level financial and non-financial institutions in support of small business development, MSME Act	9
	Human Resource Management	Introduction, definition, types, tools of motivation, Theories of motivation- Alderfer's ERG theory, Herzberg's theory of motivation, Mc Clelland theory. Introduction, objectives, scope, functions. Introduction to concept of IR. Regulation and abolition of Contract Labour Act 1970	8

Total= 48

Recommended Books:

Author	Title	Publisher
Stephen P. Robbins, Mary	Management	Pearson education Asia
Nicholas, Siropolis Houghton Mifflin company	Entrepreneurship & Small Business Management	Boston-Newyork
David H.Holt	Entrepreneurship New venture creation	PHI
Vasant Desai	Dynamics of entrepreneurial development & Management	Himalaya Pub. House
A. Nag	Macro Economics for management Students	Macmillan India Ltd.
Mote and Paul	Managerial Economics	TMH
Nigam, Sharma	Advanced Cost Accounting	Himalaya Publishing House
R. Panneerselvam	Engineering Economics	
Samuelson, Pauls & W.D. Nordhan	Economics	McGraw Hill

Title of the course : Packaging Technology
Subject Code : FT-622
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Definitions; objectives and functions of packaging and packaging materials. Labelling types; functions and regulations.	2
	Properties of Packaging Material	Packaging requirements and selection of packaging materials; properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength and their methods of testing and evaluation	6
	Packaging materials	(a) Paper: pulping; fibrillation and beating; types of papers and their testing methods; paper board (b) Glass: composition; properties; types of closures; methods of bottle making (c) Metals: Tinplate containers; tinning process; components of tinplate; tin free steel (TFS); types of cans; aluminium containers; lacquers (d) Plastics: types of plastic films; laminated plastic materials; coextrusion; edible films; biodegradable plastics	8
	Barrier properties of packaging materials	Theory of permeability; factors affecting permeability; permeability coefficient; gas transmission rate (GTR) and its measurement; water vapour transmission rate (WVTR) and its measurement; prediction of shelf life of foods; selection and design of packaging material for different foods.	6
2	**Packaging equipment and machinery**	Vacuum packaging machine; gas packaging machine; seal and shrink packaging machine; form-fill-seal machine; bottling machines; carton making machines.	6
	Food packaging systems	Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods	8
	Specialized techniques in food packaging	Active packaging system; retortable pouches; aseptic packaging; controlled and modified atmospheric packaging; irradiation in food packaging	6

Total=42

Recommended Books:

Author	Title	Publisher
Frank A. Paine	A Handbook of Food Packaging	Blackie Academic
Stanley Sacharow and Griffin	Food Packaging	AVI Publications
A.S. Athalye	Plastics in Packaging	Tata Mc-Graw Hill
Gordon L. Robertson	Food Packaging: Principles and Practice	Marcell Dekker

FT-622 (P)
Packaging Technology Lab

1. To estimate wax content of wax paper.
2. To determine the bursting strength of a carton board.
3. To determine the amount of tin coating in a can plate.
4. To determine tensile strength & Young's Modulus of given material.
5. Testing of lacquered tin plate steel for following: -
   i). Continuity of tin layer
   ii). Resistance of lacquer to acid.
6. Determination of iron content in canned foods.
7. Test for alkalinity on the surface of glass jar.
8. To study the effect of shrink and vacuum packaging on storage of food material.
9. To study the compression strength of a box.
10. To study the puncture resistance of a cardboard.
11. To study the drop resistance of a given packaging material.
12. To determine thickness of plastic film using gauge meter.
13. To determine tensile strength of a given test material.
14. To study and construction of
    i). Seal and Shrink machine.
    ii). Vacuum packaging machine.
15. To determine moisture content and shelf life of a given product.

Title of the course : Technology of Fats and Oils
Subject Code : FT-623
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Importance and functions of fats and oils in foods and health, composition of fats/oils from different animal sources and oilseeds	4
	Oil extraction	Different methods of oil extraction, oil expression from oilseeds like, mustard/rapeseed, coconut, sunflower, groundnut, sesame, cotton. Machines (Mechanical expellers and solvent extractors) used in the expression of oils, Calculations based on the extraction processes	10
	Oil/fat purification	Refining techniques, bleaching, refining losses and deodorization, Batch and continuous refining losses.	6
	Hydrogenation	Chemistry of hydrogenation, Effect of process conditions, Hydrogenation in Practice, Catalysts and catalysis.	6
2	**Chemistry of fats and oils**	Lipolysis, auto-oxidation, thermal decomposition, chemistry of frying oils, effects of ionizing radiation in fats, inter-esterification, reversion	6
	Technology of individual fat products	Butter, Margarine, Shortening, Lard, Salad, cooking and frying oil.	4
	Different quality parameters	Peroxide value, Saponification value, Iodine value, acid value, TBA, RM value, P-value, Kries value, Adulteration in oils and fats.	4
	Soap processing	Chemistry, physical properties of soap, processing and finishing, different types of soaps, soaps in cosmetics and toiletries.	4

Total=44

Recommended books:

Author	Title	Publisher
Chrysam, Erickson and others	Bailey's Industrial Oil and Fat Products	Interscience Pub., NY
Fennema	Food Chemistry	Marcel Dekker, Inc.
Meyer	Food Chemistry	
Lawson	Food oils and fats	
Maran	Fats in food products	
Acharya	Oilseeds and Oil Milling in India(A cultural and history survey)	Oxford and IBH Pub. Company

FT-623 (P)
Technology of Fats and Oils Lab

1. Determination of moisture content in fat.
2. Determination of melting point of fat.
3. Determination of specific gravity of fat.
4. Determination of % impurities / gum in fat.
5. Qualitative checking of various adulterants in labs.
6. Extraction of oil from rice brain, pellets and spent wash.
7. Determination of iodine value.
8. Determination of saponification value.
9. Determination of free fatty acids.
10. Determination of unsaponifiable matter.
11. Colour measurement of fat.
12. Determination of RM &P valve.
13. Determination of refractive index of fat.
14. Effect of particle size on the amount of oil extracted
15. To visit oil processing industry

Title of the course : Technology of Beverages
Subject Code : FT-624
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Beverage and its importance in modern life; current status of beverage industry in India	1
	Bottled Water	Water treatment before its utilization in beverages; mineral water; bottled water; quality standards of water	5
	Soft drink	Technology of carbonated soft drinks; role of various ingredients of soft drinks; carbonation of soft drinks	6
	Tea	Tea plantation; processing of black tea, green and semi fermented tea; grading of tea; chemical and biochemical changes during processing of tea	8
2	**Coffee**	Structure of coffee bean; processing of green coffee beans (dry and wet processes); conversion of green coffee into beverage; manufacturing of instant and decaffeinated coffee; chemical changes during coffee processing	8
	Cocoa	Cocoa plantation; processing of raw bean and role of fermentation; roasting procedure; processing of roast bean; chemical changes during various stages of processing	8
	Alcoholic beverages	Production of Beer; role of yeast in Beer and other alcoholic beverages; ale beer; lager beer; technology of brewing process; Wine and related beverages; Distilled spirits.	6

Total= 42

Recommended books:

Author	Title	Publisher
Varnam and Sutherland	Beverages - Technology, Chemistry and Microbiology	ASPEN
Lea and Piggot	Fermented Beverage Production	

FT-624 (P)
Technology of Beverages Lab

1. Determination of alkalinity of potable water
2. Determination of chloride content of potable water
3. Determination of hardness of potable water by EDTA method
4. Study the process of fermentation
5. Study the process of distillation
6. Estimation of alcoholic content of alcoholic beverages
7. Estimation of caffeine content of tea
8. Estimation of caffeine content of coffee
9. Preparation of grape wine
10. Preparation of cider
11. Study the process of malting
12. Study the process of carbonation
13. Visit to bottling plant
14. Visits to beverages plants

Title of the course : Technology of Bakery and Confectionery Products
Subject Code : FT-625
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Global status of Bakery and Confectionary industry	4
	Raw material for bakery products	Essential and optional raw materials for bakery products, Dough development, Methods of dough mixing, Dough chemistry, Rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data	6
	Manufacturing of bakery products	Detailed description of unit operations for the manufacturing of bakery products-Bread, Biscuits, Cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking	12
2	**Manufacturing of confectionary products**	Characteristics and processing of raw material; Technology of manufacturing of toffee, chocolate, fruit drops, hard boiled candies, bars, chewing gums, bubble gums and special confectionary products; colour, flavour and texture of confectionary; standard and regulations	12
	Equipment used in bakery and confectionary industry	Construction and working of various equipments like Mixers, proofing chambers, dough dividers, moulder and sheeter, baking ovens, cooling chamber, sealing and packaging machines, Rolling and cutting machines project profile of bakery and confectionary unit	10
			Total=44

Recommended Books:

Author	Title	Publisher
SB Arora	Hand book of Bakery Products	SIRI
Matz	Bakery Technology and Engineering	AVI
Dendy & Dobraszczyk	Cereal and Cereal Products	Aspen.
Hoseney RS	Principles of Cereal Science and Technology	AACC
Kent NL	Technology of Cereals	Pergamon Kulp K
Kulp K & Ponte GJ	Handbook of Cereal Science and Technology	Marcel Dekker
Lorenz KL	Handbook of Cereal Science and Technology	Marcel Dekker

FT-625 (P)
Technology of Bakery and Confectionery Products Lab

1. Determination of dough relaxation constants and their interpretation
2. Effect of mixing method on the quality of baked product
3. Effect of mixing time on the textural characteristics of dough
4. Effect of mixing time on the crispness and firmness of biscuits
5. Effect of additives on the quality and textural characteristics of buns
6. Development and quality evaluation of baked products based on composite flour
7. Determination of chroma and hue of baked product
8. Preparation and quality evaluation of croissant
9. Preparation and quality evaluation of masala cake
10. Preparation and quality evaluation of rich and lean cake
11. Preparation and quality evaluation of doughnuts
12. Preparation and quality evaluation of pizza base
13. Effect of syrup consistency on the quality characteristics of hard-boiled sweets
14. Effect of temperature on the quality characteristics of hard-boiled sweets
15. Preparation and quality evaluation of chocolate
16. Visit to Bakery and confectionery industries

Title of the course : Spices and Flavour Technology
Subject Code : FT-711
Weekly load : 5 **LTP**3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Status and scope of spice and flavour processing industries in India; Spices, Herbs and seasonings: sources, production, selection criteria; flavours: commercially available materials, classification on the basis of origin, physical characteristic.	10
	Processing technology of Spices	Chemical composition, processing methods, equipments used; recent developments in processing, retention and recovery of flavour; effect of processing on spice quality: contamination of spices with micro-organisms and insects	8
	Spice Essential Oils	Definition, methods of extraction, isolation, encapsulation	10
2	**Flavour Technology**	Liquid and Solid flavour production; Flavouring remixing: flavour intensifiers: synthetic flavours; effect of processing on flavour quality.	6
	Spice Oleoresins	Definition, method of extraction, isolation, separation equipment	6
	Spices and flavour quality evaluation	Criteria for assessment of flavour quality; methods of flavour evaluation (chemical, instrumental, sensory); Indian standards for flavoring materials and flavours.	4

Total=44

Recommended books:

Author	Title	Publisher
Reineccius,G	Source book of flavour	CBS
Morton,I.D., Macleod ,A.J	Food Flavours	AVI

FT-711 (P)
Spices and Flavour Technology Lab

1. Spice analysis.
2. Separation of flavoring compounds and their evaluation.
3. Detection of adulteration in spices.
4. Sensory analysis of flavored foods.
5. Correlation of subjective and objective methods.
6. Separation, purification and identification of some flavoring principles.
7. Formulation of food flavorings.
8. Extraction of essential oils
9. Extraction of oleoresins
10. Quality analysis of flavored foods

Title of the course : Food Processing Plant Layout and Design
Subject Code : FT-712
Weekly load : 3 **LTP** 3-0-0
Credit : 3 (Lecture 3; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Plant design concepts, General design considerations for food processing industries, stages of plant design	3
	Plant location	Introduction, factors involved in plant location decision, Territory and site specific factors, Influence of location on plant layout, Subjective, qualitative and semi-quantitative techniques for evaluating plant location alternatives: equal weights method, variable weights method, weight-cum-rating method, locational break-even analysis, Bridgeman's dimensional analysis, composite measure method and median model of location problem	8
	Plant Layout	Types of manufacturing process, Plant layout problem, objectives and principles of layout; classical types of layout Viz. product layout, process layout and stationary layout; plant layout tools and techniques like process charts, process flow diagram, Travel chart, machine data cards, material movement patterns, visualization of layout by templates, machine models and sketches, general guidelines for plant layout, space requirement for machines, work stations and storage, symbols used for plant design and layout plant layout procedures	11
2	**Project Management**	Project planning, Techniques of project planning, Project scheduling, Methods of project scheduling: Gantt charts and Network scheduling, Basic terms, objectives and advantages of Network analysis, various Network techniques like PERT and CPM and related numerical problems	6
	Cost Analysis	Classification of costs, analysis of production costs, depreciation and different method of calculating it, break-even point	5
	Plant Equipment and Buildings	Materials of construction of Food Equipment: Characteristics of suitable construction material like Stainless steel, Aluminum, Nickel and Plastic Materials; Hygienic construction and design concepts; Types of factory buildings; Consideration in building design, drainage, ventilation and illumination in food processing industries	5
	Layout of different industries	Considerations in the layout of different types of food industries like Bakery, soft drinks, canning, dairy, rice mill and wheat mill.	6

Total=44

Recommended books:

Author	Title	Publisher
O.P. Khanna	Production Engg. and Industrial Management	
Moore	Plant Layout and Design	John Wiley
Mart and Telsang	Industrial engineering and production management	
Peterse and Timmerhaus	Plant Design for Chemical Engg.	Mc Graw Hill
Rase and Barrow	Project Engg. of Process Plant	
Farrall	Engg. for Dairy and Food Products	

Title of the course : Innovative Techniques in Food Processing
Subject Code : FT-713
Weekly load : 3 **LTP** 3-0-0
Credit : 3 (Lecture 3; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Membrane technology**	Introduction to pressure activated membrane processes: microfiltration, UF, NF and RO and their industrial application	6
	Supercritical fluid extraction	Concept, property of near critical fluids NCF, extraction methods	4
	Microwave and radio frequency processing	Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying	6
2	**Hurdle technology**	Types of preservation techniques and their principles, concept of hurdle technology and its application.	4
	High Pressure processing	Concept, equipments for HPP treatment, mechanism of microbial inactivation and its application in food processing.	4
	Ultrasonic processing	Properties of ultrasonic, application of ultrasonic as processing techniques	4
	Newer techniques in food processing	Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation	12
	Nanotechnology	Principles and applications in foods.	4

Total=34

Recommended books:

Author	Title	Publisher
G. W. Gould	New Methods of Food Preservation	CRC
R.P. Singh	Introduction to Food Engineering	CRC
Barbosa-Canovas	Novel Food Processing technologies	CRC

Title of the course : Numerical Computations in Food Processing Industry
Subject Code : FT-714 A
Weekly load : 3 **LTP** 3-0-0
Credit : 3 (Lecture 3; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Food Process Design Requirements and Numerical Computations, Algorithms and Iterative Techniques, Errors in Numerical Computations, Basic Numerical Methods	10
	Analyzing and Solving Food Process Engineering Problems	Fluid Flow in Pipes, System Resistance and Pump Selection Heat and Moisture Transfer in Food, Psychometric Processes and Drying Simulation Fluid-Particle Interactions in Separation and Transport Processes	15
2	**Computer Modelling of Selected Food Processing Operations**	Analysis of Drying Data, Drying and Aeration Systems, Heating and Cooling Operations, Thermal Processing of Foods, Diffusion Processes	15
			Total=40

Recommended books:

Author	Title	Publisher
P.K. Chandra and R.P. Singh	Applied Numerical Methods for Food and Agricultural	
S. C. Chapra and R. P. Canale	Numerical Methods for Engineers	Mc Graw Hill, NY
R. T. Toledo	Fundamentals of Food Process Engg.	

Title of the course : Industrial Microbiology
Subject Code : FT-714 B
Weekly load : 3 **LTP**3-0-0
Credit : 3 (Lecture 3; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Introduction, scope and historical developments; Isolation screening and genetic improvement of industrially important organisms.	10
	Fermenter	Fermenter design and various types of fermentation systems (submerged, surface and solid state); Fermentation substrates, principles and production of amino acids, enzymes, nucleotides, organic acids, food colours, Baker's yeast, alcoholic beverages, vinegar.	10
2	**Secondary metabolites**	Principles and production of microbial proteins, lipids, polysaccharides and vitamins – properties and applications; mushroom cultivation.	10
	Industrial waste disposal and utilization	Utilization and disposal of industrial wastes through microorganisms; use of genetically modified microorganisms in food processing.	10

Total=40

Recommended Books:

Author	Title	Publisher
Perman D. 1977-79	Annual Reports of Fermentation Processes. Vols. I-III	
Prescott SC & Dunn CG. 1959	Industrial Microbiology.	Mc Graw Hill
Waits MJ. 2001	Industrial Microbiology.	Blackwell Science
Ward OP. 1989	Fermentation Biotechnology.	Prentice Hall

Title of the course : Technical Communication & Soft Skills
Subject Code : HU-711/ HU-721
Weekly load : 4 **LTP** 2-0-2
Credit : 0 (Lecture 0; Practical 0)

Unit	Main topic	Detailed contents	Lectures
1	**Speech Mechanism**	Introduction to English Speech Sounds: Consonants and Vowels (basics only), Organs of Speech, Description & Classification of Consonant Sounds, Cardinal Vowel Scale	8
	Oral Presentation and Professional Speaking	Elements of effective presentation, Body language and use of Audio-Visual Aids during presentation, Planning and preparing a model presentation, Organizing the presentation to suit the audience and context	8
2	**Business Communication**	Business Letters-Placing, Cancelling, Complaints, Reply to Complaints, Notices, Agendas; Minutes of Meetings, Memorandums	8
	Career-Oriented Communication	Resume and Bio-data- Design and style, Applying for a job, Language and format of a job application, Job Interview- Purpose and process, How to prepare for an interview, Language and style to be used in an interview, Types of interview questions and how to answer them	8

Total=32

Recommended Books:

Author	Title	Publishers
Mishra, Sunita & C. Muralikrishna	Communication Skills for Engineers	Pearson
Gimson, A.C	An Introduction to Pronunciation of English	ELBS.
Jones, Daniel	English Pronouncing Dictionary	ELBS
Bhattacharya, Indrajit	An Approach to Communication Skills	Dhanpat Rai & Co
Sharma, R.C. & Krishna Mohan	Business Correspondence and Report Writing	Tata McGraw-Hill

HU-711/ HU-721 (P)
Technical Communication & Soft Skills Lab

1. Self Description, Analysis and Interaction.
2. Oral Presentation on a Given Topic.
3. Group Discussion/ Debate on a Given Topic.
4. Reading a Literary Text and Preparing a Summary.
5. **L**earning Etiquettes in Communication: accepting/ arguing against others' views/ ideas, interrupting others' talks, addressing higher officials, colleagues, sub-ordinates.
6. Individual Power Point Presentations.
7. Team Project Work: Selecting a Survey Topic and collecting relevant material from the Library/ Internet Sources.
8. Designing a Questionnaire and Conducting the Survey.
9. Presenting the survey results and compiling the project report.
10. Visual Comprehension: Movies, Documentaries, Video Lectures and Summarizing.
11. Pronunciation Improvement Exercises.
12. Role Plays.
13. Mock Interviews.
14. Creative Writing: Poems, Articles, Stories etc.

Title of the course : Process Technologies for Pulses and Oilseeds
Subject Code : FT-721
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Present Status and future prospects of pulses and oil Seeds**	Major legumes, oilseeds and pulses grown in the country and their application, present Status and future prospects of pulse milling industry in India.	6
	Morphology and classification of pulses and oilseeds	Morphology and Classification of pulses and oilseeds. Chemical composition and nutritional value. Anti-nutritional factors, their chemistry, methods of removal of anti-nutritional factors	6
	Dehulling and Milling of pulses and oilseeds	Methods of dehulling-. Home, cottage and commercial scale. Modern techniques of dehulling. Milling of pulses and oilseeds: Dal milling principles, methods, equipments and effect on quality. Principle products, fermented products of legumes	6
2	**Processing of pulses and oilseeds**	Soaking principles, methods of soaking, sprouting, puffing, and roasting. Physical and biochemical changes during these processes. Protein foods: tofu, miso, texturized vegetable protein, hydrolyzed vegetable protein, formulation and quality control	12
	Cooking quality of dhal	Cooking quality of dhal, methods, factors affecting quality of dhal, cooking of dhal, quick cooking of dhal and instant dhal.	4
	Oil extraction and Refining of oils	Oil extraction methods: mechanical Pressing. Solvent extraction process: principle, pretreatment-breaking, cracking, flaking, extraction principle and Desolventization. Factors affecting the extraction process. Refining of oils: Refining, degumming, neutralization, bleaching, filtration, deodorization of oils and their principles and process controls.	10

Total=44

Recommended books:

Author	Title	Publisher
Chakraverty, A. 1988	Post harvest Technology of Cereals, Pulses and oilseeds	Oxford and IBH
B.D. Shukla	Oil Seed Processing Technology	
Mathews, R.H. Ed. 1989	Legumes: Chemistry, Technology and Human Nutrition	
Kay DE.	*Food Legumes*. Tropical Products Institute	ICAR

FT-721 (P)
Process Technologies for Pulses and Oilseeds Lab

1. Physical properties of pulses and oil seeds
2. Pre-treatment's for milling of pulses
    a) Application of water
    b) Application of oil
    c) Application red earth slurry.
    d) Application of steam
3. Dhal milling process.
4. Cooking quality of dhal
5. Fermented product of legumes- dosa, idli, wada, dhokala,
6. Production of protein rich product.
7. Solvent extraction of selected oilseeds
8. Visit to dhal mill and oil industries.

Title of the course : Health and Functional Foods
Subject Code : FT-722
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Definition, status and scope of health and functional foods in India, Definition of nutraceuticals and their importance.	5
	Types of functional foods	Types of health and functional foods and their properties	5
	Food constituents	Various food constituents responsible for functional effects -Anti-carcinogenic, hypocholesterolemic and hypoglycemic foods - Dietatic foods, anti-ageing foods - Fortified foods, diabetic foods - Biofedic, prebiotics and probiotic foods	10
2	**Processing and selection criteria**	Processing of health and functional foods, criteria for selection of raw materials, and their processing.	6
	Storage, packaging and labelling	Storage, packaging and labeling of health and functional food.	4
	Marketing aspects	Marketing aspects of health and functional foods	4
	Safety aspects	Safety / Legal aspects of health and functional foods.	4
	Organic and GM foods	Organic foods and Genetically Modified (GM) foods in relation to health	4

Total=42

Recommended Books:

Author	Title	Publisher
R. Chadwick,S. Henson,B. Moseley,G	Functional Foods	CRC Press
W. Jeffrey Hurst	Methods of Analysis for Functional Foods and Nutraceuticals	
Mazza	Functional Foods	Technomic Press
Robert E.C. Wildman	Handbook of Nutraceuticals and Functional Foods	CRC Press

FT-722 (P)
Health and Functional Foods Lab

1. Determination of antioxidants of given food samples.
2. Estimation of dietary fibers of given food sample.
3. Estimation of lycopene.
4. Estimation of carotenoids.
5. Assay of enzymes; kinetics of any one enzyme and determination of Michaelis – Menten constant.
6. Chromatographic experiments
7. Determination of vitamins A.
8. Determination of beta carotene.
9. Estimation of pectic substances from plant material.
10. Enzymatic clarification of fruit juices.
11. Preparation of SCP products.

Title of the course : Food Laws and Regulations
Subject Code : FT-723
Weekly load : 4 **LTP** 4-0-0
Credit : 4 (Lecture 4; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction**	Concept and meaning of Food quality and food Safety, food adulteration, food hazards, Natural toxins. Essential commodities Act, Standards of Weights and Measures Act, Agmark, Bureau of Indian Standards, Export and Quality Control	6
	Food Laws and Standards in India	Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, 2011. Agricultural Produce Act, 1937 (Grading and Marketing), Sugar (Control), Order, Export (Quality Control & Inspection), Act, 1963 and Rules, Bureau of Indian Standards, Ministry of Health & Family Welfare – delivery Health Services in India, The Labeling of Food Products in India.	12
	International food laws and regulatory agencies.	International Organizations – FAO (Food & Agriculture Organization), WHO (World Health Organization), Codex Alimentarius, ISO, WTO. National Organizations – ICMR, ICAR, Council for social welfare, International Food Control Systems including CODEX	8
2	**Safety aspects of food products**	Safety aspects of water and beverages such as soft drinks, tea, coffee, cocoa. Safety assessment of food contaminants and pesticide residues.	4
	The Regulation of Irradiated Foods	Exposure, estimation, toxicological requirements and risk assessment.	4
	The Regulation of Biotechnology and Genetic Modifications	Regulation of Genetically Modified Organisms, Regulation of Products Derived from Genetically Modified Organisms, Regulatory agencies: the Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and the Environmental Protection Agency (EPA).	10

Total=44

Recommended books:

Author	Title	Publisher
Ronald S	Pearson's Composition and Analysis of foods	
Ranganna	Handbook of Analysis of Fruit and Vegetable and their Products	Tata Mc Graw Hill
Pomeranz and Meloan	Food Analysis	Aspen Publisher

Title of the course : Technology of Snack Foods
Subject Code : FT-724 A
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Technology for grain-based snacks**	Whole grains – roasted, toasted, puffed, popped and flakes, coated grains-salted, spiced and sweetened; flour based– batter and dough based products; *savoury* and *farsans*; formulated chips and wafers, papads, instant premixes of traditional Indian snack foods.	6
	Technology for fruit and vegetable based snacks, Technology for coated nuts	Chips, wafers; salted, spiced and sweetened; *chikkis*	4
2	**Extruded snack foods**	Formulation and processing technology, coloring, flavoring and packaging.	4
	Equipments	Equipments for frying, Baking and drying, toasting, roasting and flaking, popping, blending, Coating, chipping.	4

Total=18

Recommended books:

Author	Title	Publisher
Edmund WL	Snack Foods Processing.	AVI Publ
Frame ND	The Technology of Extrusion Cooking.	Blackie Academic
Gordon BR	Snack Food.	AVI Publ
Samuel AM.	Snack Food Technology.	AVI Publ

FT-724 (P)
Technology of Snack Foods Lab

1. Preparation of various snack foods based on cereals.
2. Preparation of various snack foods based on legumes.
3. Preparation of various snack foods based on nuts.
4. Preparation of various snack foods based on millets.
5. Preparation of various snack foods based on vegetables.
6. Preparation of various snack foods based on fruits.
7. Extrusion product preparation.
8. Quality evaluation of various snack food based on cereals
9. Quality evaluation of various snack food based on legumes.
10. Quality evaluation of various snack food based on nuts.
11. Quality evaluation of various snack food based on millets.
12. Quality evaluation of various snack food based on vegetables.
13. Quality evaluation of various snack food based on fruits.
14. Development of instant food premixes.
15. Determination of shelf life and packaging requirement of snack foods

Title of the course : Food Additives and Ingredients
Subject Code : FT-724 B
Weekly load : 5 **LTP** 3-0-2
Credit : 4 (Lecture 3; Practical 2)

Unit	Main Topic	Detailed Contents	Lectures
1	**Food additives**	Definitions, classification and functions, Preservatives, antioxidants, colors and flavors (synthetic and natural), emulsifiers, sequesterants, humectants, hydrocolloids, sweeteners, acidulants, buffering salts, anticaking agents, etc. - chemistry, food uses and functions in formulations; indirect food additives; toxicological evaluation of food additives.	12
	Flavour technology	Types of flavors, flavors generated during processing – reaction flavors, flavor composites, stability of flavours during food processing, analysis of flavours, extraction techniques of flavours, flavour emulsions; essential oils and oleoresins; authentication of flavours etc.	12
2	**Proteins, starches and lipids as functional ingredient**	Isolation, modification, specifications, functional properties and applications in foods and as nutraceuticals	10
	Applications	Manufacturing and applications of fibres from food sources, fructo-oligosaccharides.	8

Total=42

Recommended books:

Author	Title	Publisher
Branen AL, Davidson PM & Salminen S	Food Additives	AVI Publishing House, NY
George AB	Encyclopaedia of Food and Color Additives. Vol. III	CRC
George AB	Fenaroli's Handbook of Flavour Ingredients	CRC
Madhavi DL, Deshpande SS & Salunkhe DK	Food Antioxidants: Technological, Toxicological and Health Perspective	
Morton ID & Macleod AJ	Food Flavours. Part A, BC. Elsevier	

FT-724 (P)
Food Additives and Ingredients Lab

1. Estimation of preservatives
2. Estimation of sweeteners
3. Estimation of fibers
4. Estimation of colors
5. Estimation of antioxidants
6. Flavour enhancers
7. Isolation, modification, and functional properties of native proteins
8. Isolation, modification, and functional properties of modified proteins
9. Isolation, modification, and functional properties of starches
10. Isolation, modification, and functional properties of lipids
11. Extraction of essential oil
12. Extraction of oleoresins
13. Applications of additives and ingredients in foods.

Title of the course : Separation Technology
Subject Code : FT-725
Weekly load : 3 **LTP** 3-0-0
Credit : 3 (Lecture 3; Practical 0)

Unit	Main Topic	Detailed Contents	Lectures
1	**Introduction to various separation processes**	Introduction to various separation processes; Gas-Liquid, Gas–Solid, Liquid-Liquid, Liquid-Solid separation; Concept of phase equilibrium, Stage equilibrium, Equilibrium concentration; Single stage contact equilibrium, counter-current multiple contact stages, Determination of optimum number of contact stages by analytical and graphical method; Rate of extraction, Rate of gas absorption, Individual and over all mass transfer coefficient; Calculation of tower height for gas absorption. Construction and working mechanism of different extraction equipments like single stage extraction, Multiple stage static bed system, Bollmann extractor, Hildebrandt extractor, Rotocell extractor.	10
	Solid Separation Process	Introduction, Concept of size, Shape, Cut-size, Sieving, Magnetic separation, Eddy-current separation, Wet separation, Ballistic separation, Color separation.	3
	Wet separation process	Liquid-solid and liquid- liquid separation by hydroclones, Surface velocity classifier, Elutriators, Impingement separator, Electrostatic precipitation.	4
	Distillation	Introduction, boiling point diagram, differential or simple distillation, Flash or equilibrium distillation, Continuous rectification with and without reflux, Reflux ratio, Optimum reflux ratio, Batch distillation, Application of distillation in food processing	5
2	**Membrane Technology**	Introduction to microfiltration, Ultrafiltration, Reverse osmosis, Electro dialyses, dialyses, physical characteristics of membrane separation, Factors affecting reverse osmosis process, Concentration polarization, Design of reverse osmosis and ultra filtration systems, Operation layout of the modules, Electrodialysis, pervaporisation, Application of membrane technology in food industry	10
	Powder Technology	Classification off powder, Separation of powder, Sieving, Air classification, Factors affecting air classification, Cyclone application, Air separation, Particle size distribution**.**	6
	Super Critical Fluid Extraction	Introduction, Properties of SCF,	8

Total=46

Recommended books:

Author	Title	Publisher
Grandison A S & Lewis M J	Separation Process in The Food & Biotechnology Industries	Woodhead Pub Ltd
Narayanan CM & Bhattacharyya BC	Mechanical Operations For Chemical Engineers	Khanna Pub
Dutta B K	Mass Transfer & Separation Process	PHI
Anantharaman N & Begum KMMS	Elements of Mass Transfer	PHI