Semester-Wise Programme structure for B.Tech. FSTP [4 year]

Sr. No.	Year 1		Year 2		Year 3		Year 4	
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**	**Semester 7**	**Semester 8**
1	Basic Physics-I (PHY102) [**CU:3**; L-2, P-1] {BSC}	Mathematics for Life Sciences-II [CU:3; L-3, P-0] {BSC}	Applied Chemistry [CU:4; L-3, P-1] {BSC}	Thermodynamics (XXXXX) [CU:4; L-4, P-0] {BSC}	Technology of Dairy Products Processing (XXXXX) [CU:4; L-3, P-1] {CC}	Food Packaging (XXXXX) [CU:4; L-3, P-1] {CC}	Economics for Engineers (XXXXX) [CU:2; L-2, P-0] {HSSM}	Students will choose any two courses* 1) Food Biotechnology (XXXXX) [CU:3; L-3, P-0] {OE}
2	Environmental Studies -I (ENV101) [**CU:2**; L-2] {BSC}	Basic Physics-II for Biosciences [CU:3; L-3, P-0] {BSC}	Engineering Graphics & Drafting (XXXXX) [CU:4; L-3, P-1] {ES}	Fluid Mechanics (XXXXX) [CU:2; L-2, P-0] {ES}	Instrumental Analysis of Food (XXXXX) [CU:4; L-4, P-0] {CC}	Food Safety and Standards (XXXXX) [CU:4; L-4, P-0] {CC}	Sociology for Engineers (XXXXX) [CU:1; L-1, P-0] {HSSM}	Nutraceuticals & Functional Foods (XXXXX) [CU:3; L-3, P-0] {OE}
3	Principles of Food Technology (ENV101) [**CU:4**; L-3, P-1] {BSC}	Principles of Food Chemistry [CU:4; L-3, P-1] {BSC}	OOPs using C++ (XXXXX) [CU:3; L-2, P-1] {ES}	Fruits and Vegetables Processing (XXXXX) [CU:4; L-3, P-1] {CC}	Statistical Quality Control for Food Industry (XXXXX) [CU:4; L-3, P-1] {CC}	Food Plant Design and Process Modelling (XXXXX) [CU:4; L-3, P-1] {CC}	Law for Engineers (XXXXX) [CU:2; L-2, P-0] {HSSM}	Agri Business Management (XXXXX) [CU:3; L-3, P-0] {OE}
4	Mathematics for Life Sciences-I (MAT103) [**CU:3**; L-3, P-0] {BSC}	Basic Electrical Engineering-II (XXXXX) [**CU:4**; L-3, P-1] {ES}	General Food Microbiology (XXXXX) [CU:4; L-3, P-1] {CC}	Principles of Food Engineering (XXXXX) [CU:4; L-4, P-0] {CC}	Engineering Graphics & Drafting (XXXXX) [CU:3; L-3, P-0] {ES}	Meat, Fish and Poultry Processing (XXXXX) [CU:4; L-3, P-1] {CC}	Aspects of Indian History for Engineers (XXXXX) [CU:1; L-1, P-0] {HSSM}	Food Nutrition (XXXXX) [CU:3; L-3, P-0] {OE}
5	Basic Electrical Engineering-I (PHU110) [**CU:4**; L-3, P-1] {ES}	Data Base Management System (XXXXX) [**CU:4**; L-4, P-0] {ES}	Technology of Grain Processing (XXXXX) [CU:4; L-3, P-1] {CC}	Principles and Methods of Food Processing (XXXXX) [CU:3; L-3, P-0] {CC}	Students will choose any one course* 1) Technology of Fats and Oils 2) Technology of Beverages (XXXXX) [CU:3; L-3, P-0] {CC}	Students will choose any one course* 1) Baking and Confectionary Technology (XXXXX) [CU:4; L-3, P-1] {SE} 2) Food Flavors	Students will choose any three course* 1) Food Additives (XXXXX) [CU:4; L-4, P-0] {SE} 2) Spices and Herbs (XXXXX) [CU:4; L-4, P-0] {SE}	

						and Colors (XXXXX) [CU:4; L-4, P-0] {SE}	3) Fats And Oil Technology (XXXXX) [CU:4; L-3, P-1] {SE} 4) Technology of Frozen Foods (XXXXX) [CU:4; L-4, P-0] {SE}	
6	Heat and Mass Transfer (XXXXX) [**CU:5**; L-4, P-1] {ES}	Business Organization and Management (XXXXX) [**CU:4**; L-4, P-0] {HSSM}	Unit Operations in Food Processing (XXXXX) [CU:4; L-4, P-0] {CC}	Fermentation Technology (XXXXX) [CU:3; L-3, P-0] {CC}	Entrepreneurship and New Venture Creation (XXXXX) [CU:4; L-4, P-0] {SEC}	Big Data for Life Sciences (XXXXX) [CU:4; L-3, P-1] {SEC}	5) Bioprocess Engineering (XXXXX) [CU:4; L-4, P-0] {SE}	
7	Foreign Business Language (FOL101/ FOL102) [**CU:1**, L-1] {VAC}	Foreign Business Language (XXXXX/XXXXX) [**CU:1**, L-1] {VAC}		Personal Finance and Planning (XXXXX) [CU:4; L-4, P-0] {HSSM}			6) Waste Management and Effluent Treatment (XXXXX) [CU:4; L-3, P-1] {SE}	
8	Communication Skills (ENG101) [**CU:1**, L-1] {VAC}						Students will choose any one course from other departments, these are tentative* 1) Baking and Confectionary Technology (XXXXX) [CU:3; L-3, P-0] {OE} 2) Nanotechnology in Food Processing (XXXXX)	

							[CU:3; L-3, P-0] {OE}	
9	Behavioral Skills **(PSY101)** [CU:1, L-1] {VAC}	Behavioral Science **(XXXXX)** [CU:1, L-1] {VAC}					Project Work [CU:3; L-0, P-3] {NTCC}	Project Work [CU:18; L-0, P-18] {NTCC}
Credits	24	24	24	24	24	24	24	24
Total Programme Credits								**192**

Semester 1

B.Tech. Food Science Technology and Processing - 4 years (1st Semester)

B. Tech. Food Science Technology and Processing				Semester 1					
S. No	Course Code	Course Title	Course Type	Credit					Credit Units
				L	T	PS	FW	SW	
1	PHY102	Basic Physics -I	Basic Science Course	2	0	1	0	0	3
2	ENV101	Environmental Studies -I	Basic Science Course	2	0	0	0	0	2
3		Principles of Food Technology	Basic Science Course	**3**	**0**	**1**	**0**	**0**	**4**
4	MAT103	Mathematics for Life Sciences-I	Basic Science Course	3	0	0	0	0	3
5	PHU110	Basic Electrical Engineering-I	Engineering Science	3	0	1	0	0	4
6		Heat and Mass Transfer	Engineering Science	4	0	1	0	0	5
7	FOL101/ FOL102	Foreign Business Language	Value Added Course	1	0	0	0	0	1
8	ENG101	Communication Skills	Value Added Course	1	0	0	0	0	1
9	PSY101	Behavioral Skills	Value Added Course	1	0	0	0	0	1
		Total Credits		**24**					

PHY102 (Basic Physics-I)

L	T	P	Total Credits
2	0	1	3

Course Contents/Syllabus:

Basic Physics-I	Teaching hours
Unit I: Interference	**9 hrs**
Huygen's wave theory, Superposition principle, Conditions for sustained interference, Interference by division of Wavefront - Young's double slit experiment, Interference in thin parallel and wedge-shaped films, Newton's rings	
Unit II: Diffraction	**9 hrs**
Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a Single Slit, and N Slits, Plane Transmission grating, Rayleigh criterion and Resolving power and dispersive power of grating.	
Unit III: Polarization	**9 hrs**
Polarization of Light, Law of Malus, Brewster's Law, Birefringence, Nicol prism, Production and Analysis of Plane, Circularly and Elliptically Polarized Light, Half and Quarter Wave Plates, Optical and Specific Rotation, Laurent half shade and Bi-quartz polarimeter.	
Unit IV: Lasers and fiber optics	**9 hrs**
Introduction of Lasers, Induced Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients, Population inversion, Fundamental of Lasers, Types of Pumping, Concept of Three and Four Level Lasers, Construction and Working Lasers, Properties of Laser and its applications, Fundamental ideas about optical fibers, Classification of optical fibers, Propagation of light through fiber, Properties and Applications of Fiber Optics	

List of Experiments: **(Time: 36 hours)**

1) To determine the wavelength of sodium light by Newtons's rings method
2) To determine the angle of prism with the help of a spectrometer
3) To determine the dispersive power of the material of prism with the help of a spectrometer
4) To determine the specific rotation of sugar by Bi-quartz or Laurent half shade polarimeter
5) To determine the width of a narrow slit using diffraction phenomena
6) To determine the wavelength of a laser using diffraction grating
7) To determine the wavelength of sodium source using Michelson's interferometer
8) To determine the attenuation, numerical aperture and acceptance angle of the given optical fiber

Course Learning Outcomes:

- Understand the fundamental principles underlying wave phenomena related to interference and diffraction and their effects
- Understand linear and circular polarization and applications
- Understanding on the properties of laser and construction with its applications in various

fields

- Understand Fiber optics and optical fiber communication.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Halliday, Resnick and Walker	Fundamentals of Physics	Wiley India Pvt Ltd	2006	978-8126514427
Brijlal, Subramanyam &Subrahmanyam	Principle of Optics	S. Chand publishing, 25th edition, 2012	2006	978-8121926119
Ghatak, Ajay	Optics	Tata McGraw-Hill	4th Edition	978-9339220907
Jenkins F A,White H E	Fundamentals of optics	Mcgraw hill	4th Edition	978-0072561913

ENV101 (Environmental Studies)

L	T	P	Total Credits
2	0	0	2

Course content and syllabus

Environmental Studies	Teaching hours
Unit-1- Multidisciplinary nature of environmental studies and Natural Resources-1	**9 hrs**
Multidisciplinary nature of environmental studies: Definition, scope and importance; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Concept of sustainability and sustainable development. *Natural resources*: Land resources and land use change, land degradation, soil erosion and desertification.	
Unit-2- Natural Resources-2	**9 hrs**
Deforestation: causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal population. Water Resources-Use and over-exploitation of surface and groundwater, floods, drought, conflicts over water (international and inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources- renewable and non-renewable energy sources, use of alternate energy sources, Growing energy needs, Case studies.	
Unit-3-Ecosystems	**9 hrs**
Ecosystem: What is an ecosystem; Structure and function of an ecosystem; Energy flow in the ecosystem; Food chains, food webs and ecological succession. Case studies of the following ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	
Unit-4- Biodiversity and its conservation	**9 hrs**
Biodiversity: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity patterns and global biodiversity hot spots. India as a mega–biodiversity nation; endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; conservation of biodiversity: *in-situ* and *ex-situ* conservation of biodiversity. Ecosystem and biodiversity services: ecological, economic, social, ethical,	

aesthetic and information value.	

Course Learning Outcomes:

- Understand natural resources and evaluate limitations surrounding renewable and non-renewable resources
- Understand the nuances of ecosystem and learn about behaviour of various ecosystem
- Learn about the types, services and threats to our biodiversity and importance of conserving it.

Text/Reference Books

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
William P. Cunningham, Mary Ann Cunningham	Principles of Environmental Science	McGraw-Hill	2019	9781260219715	--
Dash and Dash	Fundamentals of ecology	Tata McGraw-Hill Education	2009	978-0070083660	--
William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo	Environmental Science: A global concern,	McGraw-Hill	2021	9781260363821	--
Gaston K.J. and Spicer, J. I.	Biodiversity – An Introduction 2nd edition	Blackwell Publishing	2004	978-1-405-11857-6	--

Principles of Food Technology

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

Principles of Food Technology	Teaching Hours
Unit I: History and evolution of food processing technology, cereals & millets	**13 hrs.**
History and evolution of food processing technology **Compositional, Nutritional and Technological aspects of Plant foods** **Cereals and Millets:** Structure and composition of cereals (wheat, rice) and millets, malting, gelatinization of starch, types of browning- Maillard & caramelization, Rice- structure and composition, parboiling of rice- advantages and disadvantages	
Unit II: Pulses, fruits and vegetables and post-harvest handling	**14 hrs.**
Pulses: Structure and composition of pulses, antinutritional constituents, soaking, germination, decortication, cooking and fermentation. **Fruits and Vegetables:** Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre. **Post-harvest changes in fruits and vegetables**-Climacteric rise, horticultural maturity, physiological maturity, Storage-induced chemical, pathological, physiological and physical changes in fruits and vegetables.	
Unit III: Milk and milk products & fats and oils	**13 hrs**
Milk: Definition of milk, chemical composition of milk, its constituents **Processing of milk**: pasteurization, homogenization, an overview of types of market milk and milk products. **Fats and Oils :** Classification and types of lipids, Refining of oils, methods of refining, advantages and disadvantages, hydrogenation, Rancidity-Types and prevention,	
Unit IV: Compositional, Nutritional and Technological aspects of Animal foods	**14 hrs**
Flesh Foods - Meat, Fish, Poultry **Meat**: Definition of carcass, concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat. **Fish**: Classification, composition, characteristics of fresh fish, spoilage of fish- physiological, biochemical, microbiological. **Poultry**: Poultry types, Structure, composition and nutritive value of hen's egg, characteristics of fresh egg, and deterioration of egg quality, difference between broiler and layers, Ante-mortem examination & slaughtering of hen, Poultry sanitation & waste disposal.	

List of Experiments: **(Time: 36 hours)**

Lab/ Practical details, if applicable:

1. To study different types of browning reactions: enzymatic and non-enzymatic.
2. To study gelatinization behaviour of various starches
3. To study the concept of gluten formation of various flours.
4. To study malting and germination.

5. To study dextrinization in foods.
6. Identification of pigments in fruits and vegetables and influence of pH and heat on them.
7. Quality inspection of animal foods- egg, meat, fish etc.

Course Learning Outcomes:

- Understand the evolution of food and food processing technology.
- Determine compositional, nutritional and technological aspects of different food systems.
- Compare post-harvest changes in raw and processed food and evaluation methods.
- Perceive knowledge of processing plant and animal foods.

Text/Reference Books

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Stewart, George F, and Maynard A. Amerine	Introduction to Food Science and Technology	New York: Academic Press,	1982	012670256X, 9780126702569	289
Bawa, A S., Chauhan, O.P, Raju. P.S.	Food Science	New Delhi: NIPA	2013	9789381450147, 9381450145	392
Potter, Norman N.	Food Science	Springer	2013	1461372631, 9781461372639	623
Hoagland, Meyer L.	Food Chemistry	New York: Van Nostrand reinhold,	2004	OCLC no. 732262042	385
De, Sukumar	Outlines of Dairy Technology	Delhi, Oxford University Press	2009	9780195611946, 978-195611946	539

MAT103 (Mathematics for Life Sciences)

L	T	P	Total Credits
3	0	0	3

Course content and syllabus

Module I: Sets, Relations and Functions	**Teaching Hours**
Sets, Types of Sets, Subsets, Complement of Sets, union and Intersection of Sets, Difference of Sets, Demorgan's Law, Cartesian product of Sets, relations, functions and their types	**14 hrs**
Module II: Permutations & Combinations and Sequences & Series	
Concept of factorial, Principle of counting, Permutations and Combinations, Binomial Theorem for positive integral index, General Term and middle term, Application problems, Arithmetic Progression (A.P.), Geometric Progression (G.P.)	**13 hrs**
Module III: Matrix Algebra	
Matrices, Types of Matrices, Addition of matrices, Subtraction of matrices and Product of matrices. Properties of Matrix Multiplication. Transpose of Matrix, Symmetric and Skew-symmetric Matrices, Inverse of Matrix.	**14hrs**
Module IV: Differential Calculus	
Algebra of limits, Continuity, Derivative of a function, Fundamental rules for differentiation, Derivatives of Implicit function, Inverse trigonometric function, Exponential and Logarithmic function, Parametric form, Logarithmic Differentiation, Successive Differentiation, Introduction to Partial derivatives and related theorems.	**13 hrs**

Course Learning Outcomes:

- After going through this course, students will be able to:
- Students will demonstrate the ability to distinguish corresponding sets as representations of relations or functions by the analysis of graphical, numeric, or symbolic data
- Students will demonstrate the ability to distinguish various arrangements, binomial theorem and representations of series
- Students will demonstrate the ability to apply the concept of matrices in real life situations
- Students will understand the concepts of Limits, Continuity and Differentiability and their applications

Text/Reference Books

1. George B. Thomas Jr., Joel Hass, Christopher Heil, and Maurice D. Weir. Thomas Calculus (Pearson)
2. James Stewart. Multivariable Calculus (Cengage)

PHU110 (Basic Electrical Engineering)

L	T	P	Total Credits
3	0	1	4

Course Contents/syllabus:

Basic Electrical Engineering	Teaching hours
Unit I: DC circuits and Network	**11 hrs**
Electrical circuit elements (R, L and C), Ohm's law, Series and parallel connections of resistance and capacitance, voltage and current sources, Kirchoff current and voltage lawanalysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems., Time-domain analysis of first-order RL and RC circuits	
Unit II: Alternating current circuits	**11 hrs**
Generation of alternating voltages and currents, Peak, Average and RMS values for alternating currents, Form and Peak factor, Power calculation, reactive power, active power, Complex power, power factor, Ac through resistance, capacitance and inductance and LCR circuit, impedance, reactance, conductance, susceptance Series and Parallel circuits, Resonance: series Resonance, parallel resonance, basic definitionof Q factor & Bandwidth., Power in choking coil.	
Unit III: Transformers	**11 hrs**
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit losses in transformers, regulation and efficiency, Auto-transformer and three-phase transformer connections	
Unit IV: Electrical Machines	**12 hrs**
Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency starting and speed control of induction motor, Single-phase induction motor. Construction working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators	

Lab/ Practical details: **(Time: 36 hours)**

List of Experiments -with basic instructions

1. To determine an unknown Low Resistance using Potentiometer
2. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
3. To verify the Thevenin and Norton theorems. In digital meters
4. To verify the Superposition, and Maximum power transfer theorems
5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance is not available at resonance, (c) Quality factor Q, and (d) Band width.
6. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
7. Determine a high resistance by leakage method using Ballistic Galvanometer
8. To determine the frequency of A.C. mains using sonometer
9. To study B-H curves for different ferromagnetic materials using C.R.O. w/o CRO

10. Studies based on LCR Board: Impedance of LCR circuit and the phase and between voltage and current.

Course Learning Outcomes: At the end of this course, the students will be able to develop basic understanding of various fundamental Laws and theorems related to electrical engineering and different electrical machine mechanisms.

- An ability to apply fundamental and advance knowledge of mathematics, science and engineering to solve and analyze the electrical and magnetic circuits
- To understand the fundamentals and applications of Alternative currents
- Learning of advanced machines applicable in day today practice such as transformers and motors

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
V.K Mehta Rohit Mehta	Basic Electrical Engineering	S.Chand Publication	2006	9788121908719	
D. P. Kothari and J. Nagrath	Basic Electrical Engineering: 4th edition	Tata McGraw Hill	2010	9789353165727	
L. S. Bobrow	Fundamentals of Electrical Engineering	Oxford University Press	2011	9780195105094	
E. Hughes	Electrical and Electronics Technology	Pearson	2010	9788131733660	
V.N Mittle and Arvind Mittle	Basic Electrical Engineering: 2nd edition	TMG publication	2017	9780070593572	

CSE103 (Introduction to Computers and Programming)

L	T	P	Total Credit Units
3	0	2	5

Course Contents/Syllabus:

	Teaching Hours
Unit I: Introduction to Computers	**13 hrs**
Introduction to Computer, history, Generations of Computer Systems, Von-Neumann architecture, Basic block diagram and functions of various components of computer, memory system (hierarchy, characteristics and types), H/W concepts (I/O Devices), S/W concepts (System S/W & Application S/W, utilities).	
Unit II: Data Representation and Programming Languages	**14 hrs**
Data Representation: Number systems, character representation codes, Binary, octal, hexadecimal and their inter-conversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, Memory storage unit Concepts of Machine level, Assembly level and high level programming, Algorithms, Flow Charts and pseudo code with examples. Introduction to Operating System with its types and significance.	
Unit III: Programming Constructs	**13 hrs**
From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code. Arithmetic expressions and precedence, Conditional Branching and Loops. Writing and evaluation of conditions and consequent branching, Iteration and loops. Concepts of array, one and two dimensional arrays, Structures	
Unit IV: Functions & Pointers	**14 hrs**
Functions (including using built in libraries), Parameter passing in functions, call by value, call by reference. Recursion as a different way of solving problems. Example programs, such as finding factorial, Fibonacci series, sum of natural numbers etc. Basics of pointers, Defining pointers, pointer to pointer, pointer and arrays.	

Note: Programming may be taught in C or any other high-level language.

Course Learning Outcomes:

i) Demonstrate the hardware components and software concepts of computer system along with their significance.
ii) Design algorithms and flowcharts for solutions various problems.
iii) Develop and debug a program using various constructs of Programming languages.
iv) Design various functions and use them to improve of efficiency of program.

Lab/practical (total teaching hours = 72 hrs)

a) Familiarization with programming environment including file extension, header files etc.

b) Write a program for addition and subtraction of 02 numbers given by user.
c) Write a program to calculate simple interest and compound interest.
d) Write a program to interchange two numbers without using third variable.
e) Write a program to read marks of a student from keyboard whether the student is pass or fail (using if else)
f) Write a program to read three numbers from keyboard and find out maximum out of these three. (nested if else)
g) Write a program to find whether the number is odd or even.
h) Write a program for sum of n natural numbers
i) Write a program to print nth number of Fibonacci series.
j) Write a program to take 10 numbers from the user and find out the maximum and minimum number.
k) Write a program to find the position of a given number in array.
l) Write a program for matrix addition.
m) Write a program for calculating simple interest with the help of function.
n) Write a program to demonstrate the difference between call be value and call by reference.
o) Write a program to print Fibonacci series using recursion.
p) Write a program to demonstrate use of pointers.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
V. Rajaraman	Fundamentals of Computer Science	PHI	6th Edition, 2015	9788120350670	626
Byron Gottfried	Schaum's Outline of Programming with C	Tata McGraw-Hill	Edition, 2010	9780070145900	
Brian W. Kernighan and Dennis M. Ritchie	The C Programming Language	Prentice Hall of India	2nd Edition, 1988	978-0131103627	288
E. Balaguruswamy	Programming in ANSI C	Tata McGraw-Hill	8th Edition, 2018	978935316513	600

ENG101 (Communication Skills-I)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

Communication Skills-I	Teaching hours
Unit I: Basic Concepts in Communication	3.5 hrs
Definition of communication, Nature and process of communication, role and purpose of communication, types and channels of communication, communication networks/flow of communication: vertical, diagonal, horizontal, barriers to communication: physical, language, and semantic, socio-psychological, organizational, gateway to effective communication, towards communicative competence, choosing the appropriate channel and medium of communication, social communication: small talk and building rapport, barriers in communication.	
Unit II: Communication Types	5.5 hrs
Verbal communication: Oral Communication: Forms, Advantages & Disadvantages, Written Communication: Forms, Advantages & Disadvantages, Introduction of Communication Skills (Listening, Speaking, Reading, Writing), Nonverbal communication: functions and effective use, KOPPACT(Kinesics, Oculesics, Proxemics, Para-language, Artifacts, Chronemics, Tactilics). The implication of appropriate communication; effective ways of using social media, importance of digital literacy.	
Unit III: Reading and Writing Skills	3 hrs
Significance of reading; Reading Comprehension, gathering ideas from a given text, identify the main purpose and context of the text, evaluating the ideas, interpretation of the text, Paragraph development; essay writing.	
Unit IV: Speaking and Presentation Skills	6 hrs
Speaking skills: fluency, vocabulary, grammar, and pronunciation; effective speaking: selection of words, your voice, and non-verbal communication, functions of speaking: interaction, transaction, and performance; structuring the message; effective speaking strategies. Planning, preparation, practice, and performance; audience analysis, audio- visual aids, analyzing the non-verbal communication, methods of delivery: impromptu, extemporaneous, memorization, manuscript, and outlining.	

Course Learning Outcomes:

- Students will be able to understand the basic processes of communication, both verbal as well as non-verbal—nature, scope, and power of communication processes.
- Students will be able to demonstrate cultural sensitivity in communication and appreciation of cultural variations of diverse socio-cultural contexts.
- Students will be able to develop an awareness of the role of mass media in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
- Students will be able to analyze situations and audiences to make right choices about the most effective and efficient ways to communicate and deliver messages.

- Students will be able to assess various barriers in communication and develop communicativecompetence thereby for effective communication.

Books/literature

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
P. D. Chaturvedi andMukesh Chaturvedi	Business Communication: Concepts, Cases and Applications	Pearson Education	2006	9788131 701720	
Meenakshi Raman and Prakash Singh	Business Communication	Oxford University Press	2012	9780198 077053	
Jeff Butterfield	Soft Skills for Everyone	Cengage Learning	2017	9789353 501051	

FOL101 (Introduction to French Culture & Language)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

Introduction to French Culture & Language	Teaching hours
Unit-I Introduction to French language	**3 hrs**
• Brief introduction of French and Francophone countries • Presenting oneself • Getting information about someone else • Greeting and taking leave • Asking/giving personal information	
Unit-II- A rendez-vous ; Visiting a place	**6 hrs**
• Pronouncing and writing numbers in French • Spell and count numbers • Telling the time • Temporal expressions • Communicating in class • Fixing an hour, place for a meeting. • Describing a person. • Identifying a person, object and place • Describing relation in a family • A specific person, object and place	
Unit-III- An interview	**4.5 hrs**
○ Description of objects, people and places ○ Nationalities ○ Speaking about one's professions ○ Expressing Actions using regular –er ending verbs; avoir, être; reflexive verbs – usage, conjuagation • • Interview of celebrity	
Unit-III- An interview	**4.5 hrs**
• Portrait by a journalist • Giving a positive or negative reply • Asking questions • Discussion with a person • Activities in a day	

Course Learning Outcomes: At the end of this course, the students will be able to express themselves in writing and orally in basic French. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to :

- Understand information; Express in his own words; Paraphrase; Interpret and

translate.

- Apply information in a new way in a practical context
- Analyse and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

Author	Title	Publisher	Year	ISBN No	Pages
Christine Andant, Chaterine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1 Livre De L'Eleve, Cahier D' Exercices	Langers Internati Private Limited	2010	978938080 9069	
Manjiri Khandekar and Roopa Luktuke	Jumelage - 1 Methode De Fraincais - French	Langers Internati Private Limited	2020	978938080 9854	
Michael Magne, Marie-Laure Lions-Olivieri	Version Originale 1: Cahier d'exercices	Maison Des Lang	2010	9788484435617	

FOL102 (Introduction to German Culture & Language)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

Introduction to German Culture & Language	Teaching hours
Unit-I Introduction to German Language (Einführung)	**3 hrs**
Introduction to German as a global language, Self-introduction and Greetings, Die Alphabeten, Phonetics: the sound of consonants and vowels, Wie buchstabieren Sie Ihren Name?	
Unit-II- Numbers and everyday conversation (die Zahl und Gespräche)	**6 hrs**
Counting in German from 1-100, Simple Calculation and verb 'kosten' - Wie viel kostet das? Plural Forms, Vocabulary: Wochentage, Monate, Jahreszeiten, Ordinal numbers and the question - Wann haben Sie Geburtstag?	
Unit-III- Regular verbs and nominative case: articles and pronouns (Regelmässige Verben und Nominativ Kasus: Artikel und Pronomen)	**4.5 hrs**
Introduction to all personal pronouns and conjugation of Regular verbs Detailed exercise on regular verbs. Reading a text on regular verbs. Introduction to definite. Vocabulary: Schulsachen und Getränke, Nominative case/ Articles (der, die, das) Nominative Pronouns: - Applicability of pronouns for both persons and things. Usage of nominative Personal Pronouns Introduction of nominative possessive pronouns usage of nominative possessive pronouns	
Unit-IV- The Family, Work-life and Professions (Familienmitglieder und Berufe) & Interrogative sentences (W-Fragen)	**4.5 hrs**
The Family, Work-life and Professions (Familienmitglieder und Berufe) Vocabulary: Professions and conjugation of the verb 'sein' Introduction to simple possessive pronouns with the help of the verb ‘haben’ Usage of possessive pronouns. Interrogative sentences (W-Fragen) W-Fragen: who, what, where, when, which, how, how many, how much, etc. Exercises on the question pronouns	

Course Learning Outcomes: At the end of this course, the students will be able to express themselves in writing and orally in basic German. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to:

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context
- Analyse and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

Author	Title	Publisher	Year	ISBN	Pages
Rolf Brusek e	Starten Wir A 1	Langers International Pvt Ltd (Max Hueber Verlag)	2017	9783190160006	
Giorgio Motta	Wir Plus Grundkurs Deutsch fur Junge Lerner Book	Ernst Klelt Verlog	2011	9788183072120	
Heimy Taylor, Werner Haas	Station en Deutsch Self Study Course German Guide	Wiley	2007	9780470165515	

PSY101 (Behavioural Science: Understanding Self for Effectiveness)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

Behavioural Science: Understanding Self for Effectiveness	**Teaching time**
Unit I: Self: Core Competency	**4.5 hrs**
Understanding of Self, Components of Self – Self identity , Self concept, Self confidence , Self image , BIG5 Factors	
Unit II: Techniques of Self Awareness	**4.5 hrs**
Exploration through Johari Window, Mapping the key characteristics of self, Framing a charter for self Stages – self awareness, self acceptance and self realization	
Unit III: Self Esteem & Effectiveness	**4.5 hrs**
Meaning, Importance, Components of self esteem, High and low self esteem, Measuring your self esteem	
Unit IV: Building Positive Attitude and Emotional Competence	**4.5 hrs**
Meaning and nature of attitude, Components and Types of attitude ,Importance and relevance of attitude Emotional Intelligence – Meaning, components, Importance and Relevance Positive and negative emotions, Healthy and Unhealthy expression of emotions	

Course Learning Outcomes: At the end of this course, the students will be able to:

- The student will apply self-introspection as a tool for self-awareness.
- The student will understand self-concept for self-recognition, self-improvement and perception of others
- The student will be able to analyze their physical self, social self, the competent self and psychological self.
- The student will be able to analyze what motivates his/her actions and the actions of others

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Singh A.	Achieving Behavioural Excellence for Success	Wiley Publication	2012	9788126580027	
Towers, Marc	Self Esteem	American Media	1995	9781884926297	
Pedler Mike, Burgoyne John,	A Manager's Guide to Self-Development	McGraw-Hill	2006	978-0077114701	

Boydell Tom					
Covey, R. Stephen	Seven habits of Highly Effective People	Simon & Schuster Ltd	2013	978-1451639612	
Khera Shiv	You Can Win	Macmillan	2005	978-0333937402	
Gegax Tom	Winning in the Game of Life	Harmony Books	1999	978-0609603925	
Singh, Dalip	Emotional Intelligence at Work	Publications	2006	9780761935322	
Goleman, Daniel	Emotional Intelligence	Bantam Books	2007	9780553095036	
Goleman, Daniel	ing with E.I	Bantam Books	1998	9780553104622	

Semester 2

B.Tech. Food Science Technology and Processing - 4 years (2nd Semester)

B. Tech. Food Science Technology and Processing				Semester 2					
S. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1		Mathematics for Life Sciences-II	Basic Science	3	0	0	0	0	3
2		Basic Physics-II for Biosciences	Basic Science	3	0	0	0	0	3
3		Principles of Food Chemistry	Basic Science	3	0	1	0	0	4
4		Basic Electrical Engineering-II	Engineering Science	3	0	1	0	0	4
5		Data Base Management System	Engineering Science	4	0	0	0	0	4
6		Business Organization and Management	HSSM	4	0	0	0	0	4
7		Behavioral Science	Value Added Course	1	0	0	0	0	1
8		Foreign Business Language	Value Added Course	1	0	0	0	0	1
				Total credits					**24**

Mathematics for Life Sciences-II

L	T	P	Total Credits
3	0	0	3

Course content and syllabus

Mathematics for Life Sciences-II	Teaching Hours
Unit I: ANALYTIC GEOMETRY	**14 hrs**
Cartesian system of rectangular coordinates: Distance Formula, Section formula, Area of Triangle, slope of the line, intercepts with axis, various form of lines, Points of intersection of two lines, Line parallel and perpendicular to a given line. Circle: General equation of a circle. Diameter form of a circle, point of intersection of a line and a circle	
Unit II: ANALYTIC GEOMETRY	**13 hrs**
Parabola: Equation of parabola in standard form, Equation of parabola given its focus and directrix; Given the equation of a parabola, determination of its locus, vertex, axis, directrix and latus rectum Ellipse and Hyperbola: Standard equation of Ellipse and Hyperbola (without proof), Writing equations given the directrix, focus and eccentricity; Determination of focus, directrix, latus rectum, axes, eccentricity and vertex	
Unit III: INTEGRAL CALCULUS	**14hrs**
Indefinite Integrals: Integration as an inverse process of differentiation, Fundamental Integration formulae, Standard results on integration, methods of Integration: Substitution, Special integrals, Parts, Partial Fractions *Definite Integrals:* Fundamental theorem of calculus, Properties of definite integrals, $\pi/2$ $\pi/2$ $\pi/4$ Reduction formulae for $\int sin^n x\, dx$, $\int cos^n x\, dx$, $\int tan^n x\, dx$ 0 Application of Integrals in finding area under the curve.	
Unit IV: ORDINARY DIFFERENTIAL EQUATIONS	**13 hrs**
Definition of Order and Degree of differential equation, Formation of ODEs, Solution of Differential Equation of 1st Order and 1st Degree: Variable Separation, Homogeneous Differential Equations, Linear Differential Equations and Bernoulli's equation, Exact Differential Equations, General Linear ODE of Second Order, Solution of Homogeneous Equation, An elementary introduction to Partial differential equations.	

Course Learning Outcomes:

After going through this course, students will be able to:

1. Students will demonstrate the ability to identify point in two-dimensional geometry along with understanding of the concepts of line, circle parabola ellipse and hyperbola.

2. Students will demonstrate the ability correlation the concept of Integration with the help of Differentiation and study its various applications
3. Students will demonstrate the ability to solve various problems of differential equation of first and higher orders.

Text / Reference Books:

Author	**Title**	**Publisher**	**Ed/year**	**ISBN No**	**Pages**
R.D. Sharma	Applied Mathematics	Dhanpat Rai Publications, New Delhi			
B.S. Grewal	Elementary Engineering Mathematics	Khanna Publishers, New Delhi			
Daniel Alexander Murray	Differential and Integral Calculus	Longmans Green and Company	2007		
Ayous and Mendelson	Differential and Integral Calculus	Schaum's Outline Series	Metric Edition, 1992.		
S C Arora and Ramesh Kumar	A Textbook of Calculus	S. Chand and Co., New Delhi			

Basic Physics-II for Biosciences

L	T	P	Total Credits
3	0	0	3

Course content and syllabus

Basic Physics-II for Biosciences	**Teaching Hour**
Unit I: Mechanical Properties of the Body	11 hrs
Kinematics, Muscular Action, Friction, Energetics, Review of Harmonic Motion, Pendulums, Moments of Inertia, Ballistic (or Pendulum) Model of Walking, Material Components of the Body, Bone, Ligaments and Tendons, Cartilage, Elastic Properties, Basic Stress-Strain Relationships Other Stress- Strain Relations.	
Unit 2: Fluids Dynamics	12 hrs
Characteristic Pressures in The Body, Definitions and Units ,Measuring Pressure , Basic Physics of Pressure and Flow of Fluids, Law of Laplace, Fluids in Motion, Equation of Continuity, Bernoulli's Equation, Interaction among the Flow Parameters , Viscous Flow and Poiseuille's Law, Diffusion, Motion of Humans in Fluids, Swimming, Human Flight	
Unit 3: Thermodynamics	11 hrs
First and second laws of thermodynamics, activation energy. Biological systems as open, non- equilibrium systems, Concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimetry.	
Unit 4: Physics of Sound Waves	11 hrs
Speed and Properties of Sound Waves, Intensity of Sound Waves, Sound propagation from one Medium to Another, Speech Production, Types of Sounds, Hearing, Other Vibrations of the Body, Cardiac and Other Sources of Sounds	

Course Learning Outcomes:

At the end of the course, students will be able to

1. Understand the material components of the body: bones, ligaments and Tendons, learning the mechanical properties of the body: stress-strain relationship, elastic behaviour as well as other mechanical aspects of bones
2. Understand the mechanism of fluid motion in the body, its function, Physics behind the fluid flow
3. Understanding of thermodynamics in biological systems.
4. Understand basics of sound with its impact on the body

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Irving P. Herman	Physics of the Human Body	Springer	2006	978-3540817062	

W. Hughes B	Aspects of Biophysics	John willey and sons	1979	978-0471019909	
R.K. Hobbie	Intermediate Physics in Biology and Medicine	Springer	2001	978-3319126814	

Principles of Food Chemistry

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

Principles of Food Chemistry	Teaching Hours
Unit I: Importance of water in foods	**14 hrs**
Definition of water in food, Structure of water and ice, Types of water, Physical properties of water, Surface tension, Colligative properties, Water activity & sorption phenomenon, Water activity and shelf-life, Water activity and reaction rate, Water activity in relation to food spoilage, processing & packaging	
Unit II: Food carbohydrates and Proteins	**13 hrs**
Carbohydrates: Classification, structure & Importance, functional properties of mono-, oligo-, & poly- saccharides including starch, cellulose, pectic substances and dietary fiber, gelatinization and retrogradation of starch. Mutarotation, caramelization, crystallization, oxidation & reduction, Modified starch, Resistant starch, Starch hydrolysates. **Proteins:** Protein structure and classification, Nature of food proteins (plant and animal origin), Properties of proteins (electrophoresis, sedimentation, amphoterism, gel formation, denaturation, precipitation & coagulation), non-enzymatic browning, Effects of processing and storage on food proteins, Functional properties of proteins, Protein intolerance (celiac disease & cow milk allergy) Proteins: biochemical changes in postmortem and tenderization of muscles.	
Unit III: Technology of edible fats/oils, vitamins and enzymes	**14 hrs**
Fats/Oils: Nomenclature, classification and physical properties of lipids, Chemical properties of lipids, Rancidity, lipolysis, flavor reversion, auto-oxidation and its prevention, Emulsion & emulsifiers, Technology of edible fats and oils: refining, hydrogenation, fractionation and interesterification, Fat replacers, Designer lipids, Fat frying and effects **Vitamins:** Classification, structure, importance and stability of vitamins, Uses in foods, Deficiency disorders **Enzymes:** Introduction & classification of enzymes & flavor, Nature & kinetics of enzymes, Immobilization of enzymes	
Unit IV: Introduction to food minerals, vitamins, colorants & pigments	**13 hrs**
Minerals: Types & classification, Interaction of minerals with food components, minerals uptake in canned foods, Deficiency & disorders **Colorants & Pigments:** Introduction and classification, Systems of colour measurement, Food application **Pigments:** carotenoids, chlorophylls, anthocyanins, tannins and myoglobin. **Food flavors:** Types of taste, Flavor enhancers, Odor, Astringency, Functional components for food flavor, terpenes, esters, aldehydes, ketones and quinines.	

Chemical and biochemical changes: changes occur in foods during different processing.	

List of Experiments -with basic instructions

1. Preparation of primary and secondary solutions
2. Determination of total ash content in foods
3. Estimation of moisture content
4. Estimation of protein content by spectrophotometer method
5. Determination of refractive index and specific gravity of fats and oils.
6. Determination of smoke point and percent fat absorption for different fat and oils.
7. Determination of percent free fatty acids
8. Determination of fat content of milk using Gerber's method
9. Estimation of saponification value
10. Determination of crude fibers in foods
11. Determination of iron content in food: colorimetric method
12. Estimation of reducing and non-reducing sugars using potassium ferricyanide method.

Course Learning Outcomes:

- To study the importance of water in foods
- To understand the role of carbohydrates and proteins in foods
- To know about the oils/fats, enzymes and flavor constituents of foods
- To understands the role of minerals, vitamins, colorants & pigments in foods

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
DeMan, John M.	Principles of Food Chemistry,	New York: Springer	2020	9783319636054, 3319636057	625
Damodaran, Srinivasan, and Kirk L. Parkin.	Fennema's Food Chemistry,	Boca Raton CRC Press	2017	9781482243611, 148224361X, 9781482208122, 1482208121,	1107
Potter, Norman N.	Food Science	Springer,	2013	1461372631, 9781461372639	623
Sehgal, Shalini,	A Laboratory Manual of Food Analysis,	New Delhi: IK International Publishing House,	2016	9789384588847, 9384588849	162
Whitehurst, Robert J, and Maarten Oort.	Enzymes in Food Technology	Chichester: John Wiley and Sons	2010	9781405183666, 1405183667	368

Basic Electrical Engineering-II

L	T	P	Total Credits

3	0	1	4

Course content and syllabus:

Basic Electrical Engineering-II	**Teaching hours**
Unit I: Magnetism and Electromagnetism	**11 hrs**
Elementary electrostatics, Magnetic Effect of Electric Current (wire and coil), Electromagnetic fields, Magnetic field due to electric current (straight wire and coil), Force on Current-carrying Conductor Placed in a Magnetic Field, Ampere's Circuital Law, Biot- Savart Law, torque experienced by a coil, Electromagnetic induction, methods of producing induced force, Generator and transformer emf, Eddy current loss	
Unit II: Magnetic circuits:	**11 hrs**
Magnetomotive force (m.m.f.), Reluctance, Permeance, theory of magnetic circuits and its analogy with electrical circuits, series and parallel magnetic circuits, Magnetic Leakage and Fringing, Kirchhoff's law for magnetic circuits	
Unit III: Fundamentals of reactive circuits	**11 hrs**
Inductance and capacitance, Self-Inductance, mutual inductance, Growth of current and time constants in RL , RC and LCR circuits	
Unit IV: Materials for electrical engineering and devices	**12 hrs**
Elementary concepts of materials, Dielectric Properties of Insulators in Static and Alternating field, Magnetic Properties and Superconductivity, Semiconductor Materials	

List of Experiments: (Time: 36 hours)

List of Experiments

Objective*:* To emphasize the role of Physics in day-to-day life.

1. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
2. To study C.R.O. as display and measuring device by recording sines and square waves, output from a rectifier, verification (qualitative) of law of electromagnetic induction and frequency of A.C. mains.
3. To plot the Lissajous figures and determine the phase angle by C.R.O
4. To determine self-inductance of a coil by Anderson's bridge
5. To determine the mutual inductance of two coils by Absolute method.
6. To measure thermo e.m.f. of a thermocouple as a function of temperature and find inversion temperature
7. To study the characteristics of a PN junction with varying temperature & the capacitance of the junction w/o CRO
8. To study the characteristics of a LED and determine activation energy
9. To study temperature-dependence of conductivity of a given semiconductor crystal using four probe method.

Course Learning Outcomes:

At the end of this course, the students will be able to develop basic understanding of Physics phenomenon related to human health.

- An ability to apply fundamental and advance knowledge of magnetism and electromagnetism to understand the magnetic circuits
- To understand the fundamentals and applications of magnetic circuits

- Learning of Fundamentals of reactive circuits and time constants
- Understanding the other materials and devices used in electrical engineering

Text/Reference Books:

Author	Title	Publisher	Year	ISBN	Pages
V.K Mehta and Rohit Mehta	Basic Electrical Engineering	S.Chand publication	2006	978-8121908719	
D. P. Kothari and I. J. Nagrath	Basic Electrical Engineering: 4th edition	Tata McGraw Hill	2010	978-9353165727	
D. C. Kulshreshtha	Basic Electrical Engineering: 2nd edition	McGraw Hill	2009	978-9353167219	
L. S. Bobrow	Fundamentals of Electrical Engineering	Oxford University	2011	978-0195105094	
E. Hughes	Electrical and Electronics Technology	Pearson	2010	978-8131733660	
V. D. Toro	Electrical Engineering Fundamental: 2nd edition	Prentice Hall India	2015	978-9332551763	
V.N Mittle Arvind Mittle	Basic Electrical Engineering: 2nd edition	TMG publication	2017	978-0070593572	

Data Base Management System

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

	Teaching Hours
Unit 1: Introduction	**15 hrs**
Descriptors/Topics Concept and goals of DBMS, Database Languages, Database Users, Database Abstraction. Database architecture, The Relational Data Model and Relational Database Constraints, Basic Concepts of ER Model, Relationship sets, Keys, Mapping, Design of ER Model	
Unit II: Relational Model	**8 hrs**
The relational model, The catalog, Types, Keys, Relational algebra, Domain relational calculus, Tuple relational calculus , Fundamental operations, Additional operations, SQL fundamentals, Integrity , Triggers , Views ,Relational database, Relational Algebra, Relational & Tuple Calculus	
Unit III: Relational Database Design	**15 hrs**
Normalization using Functional Dependency, Multivalued dependency and Join dependency. Query Processing and Optimization, and Database Tuning: Translating SQL Queries into Relational Algebra, Algorithms for External Sorting, Algorithms for SELECT and JOIN Operations, Algorithms for PROJECT and Set Operations, Combining Operations Using Pipelining, Using Heuristics in Query Optimization	
Unit IV: Transaction Processing, Concurrency Control, Recovery and application	**7 hrs**
Introduction to Transaction Processing Concepts and Theory, Lock Based Protocols, Time Stamped Based Protocols, Deadlock Handling, Crash Recovery. Distributed Database, Objective Oriented Database, Multimedia Database, Data Mining, Digital Libraries.	

List of Experiments: (Time: 36 hours)

List of Experiments:

1. Write a query in SQL to display the last name and job title of all employees who do not have a manager
2. Write a query in SQL to display the last name, salary, and commission of all employees who earn commissions. Sort data in descending order of salary and commissions.
3. Write a query in SQL that prompts the user for a manager ID and generates the employee ID, last name, salary, and department for that manager's employees. The HR department wants the ability to sort the report on a selected column.
4. Write a query in SQL to Display all employee last names in which the third letter of the name is a.
5. Write a query in SQL to Display the last name of all employees who have both an a

and an e in their lastname

6. Write a query in SQL to Display the last name, job, and salary for all employees whose job is sales representative or stock clerk and whose salary is not equal to $2,500, $3,500, or $7,000.
7. Write a query in SQL to display the employee number, last name, salary, and salary increased by 15.5% (expressed as a whole number) for each employee. Label the column New Salary.
8. Create a report that produces the following for each employee: <employee last name> earns <salary> monthly but wants <3 times salary>. Label the column Dream Salaries.
9. Create a query to display the last name and salary for all employees. Format the salary to be 15 characters long, left-padded with the $ symbol. Label the column SALARY.
10. Display each employee's last name, hire date, and salary review date, which is the first Monday after six months of service. Label the column REVIEW. Format the dates to appear in the format similar to "Monday, the Thirty-First of July, 2000."
11. Display the last name, hire date, and day of the week on which the employee started. Label the column DAY. Order the results by the day of the week, starting with Monday.

Course Learning Outcomes:

After completion of this course the students will be able to

1. Create a conceptual schema from real world problem, and to define program-data independence, data models for database systems, database schema and database instances.
2. Construct relational model and create database for querying with the help of relational algebra and SQL. 3.Design and modify a database such that it is free from anomalies using normalization techniques.
4. Apply query processing techniques for optimizing queries and database tuning.
5. Compare various concurrency control techniques and database security and recovery methods for various types of databases.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Korth, Silberschatz	Database System Concepts	TMH	2011	978-939072750 6	137 6

Steve Bobrowski	Oracle & Architecture	TMH	2000	-	
Date C. J	An Introduction to Database Systems	Narosa Publishing	7th Ed., 2004	978-020138590 8	938
Elmsari and Navathe	Fundamentals of Database Systems	A. Wesley	6th Ed, 2010	978-813171625 0	--
Ullman J. D	Principles of Database Systems	Galgotia Publications	2nd Ed,1999	978-817515545 9	684

Business Organisation and Management

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

Business Organization and Management	Teaching Hours
Unit I: Introduction to Business and Management	**18 hrs**
Introduction to business, Business firms - Forms of organization - sole proprietors, Partnership, Joint-Hindu family, Joint stock Company, Co-operative organizations - Public Enterprises, BPO, E-commerce and M-commerce. Entrepreneurship – Concept & Nature. Meaning, nature and characteristics of Management - Scope and functional areas of management - Social responsibility of management and Ethics. Organizational Structure & Functions (Production, Marketing, Human resource development and finance functions)	
Unit II: Planning, Organizing and Staffing	**18 hrs**
Nature importance and purpose of planning - Planning process, Objectives - Types of plans (Meaning only) - Decision-making – importance & steps. Nature and purpose of organization, Principles of organization - Types of organization - Departmentation, Committees - Centralization Vs decentralization of authority and responsibility - Span of Control - MBO and MBE (Meaning only) – Nature and importance of staffing - Process of selection & recruitment (in brief) – retaining (training and compensation).	
Unit III: Directing and Controlling	**18 hrs**
Meaning and nature of directing - Leadership styles - Motivation theories (Maslow's, Herzberg, McGregor's X & Y theory), Ouchi's Theory- Communication meaning and importance, barriers to communication, types of communication - Coordination meaning and importance. Case Discussion (GE). Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief) – Balance score card, Economic value added, Market value added.	
Unit IV: Management in Perspective	**18 hrs**
Change Management, Knowledge Management, learning organization, Managing Diversity, Corporate Governance.	

Course Learning Outcomes:

After going through this course, students will be able to:

1. Distinguish and explain each form of business
2. Explain principles and functions of management implemented in the organization
3. Analyze the concept of Delegation of Authority, coordination, and control
4. Identify the managerial skills used in business.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Harold Koontz, Cyril O'Donnell	Principles of Management	McGraw-Hill Education	2018	9781307285598	300
Peter Ferdinand Drucker	Management : Tasks, Responsibilities, Practices	Routledge	2015	9781138129467	576
C. R. Basu	Business Organisation and Management	McGraw-Hill Education (India) Pvt Limited	1998	9780074620847	490
S. A. Sherlekar, Dr. Virendra Sharad Sherlekar	Modern Business Organisation and Management	Himalaya Publishing House	2019	9789352021864	1122
Jagdish Prakash	Business Organization and Management	Kitab Mahal	1999	9788122500288	851

BHA103: Individual, Society and Nation

L	T	P	Total Credit Units
1	0	0	1

Course Contents/syllabus:

Individual, Society and Nation	Teaching Hrs
Unit-I- Individual differences & Personality	**4 Hrs**
• Personality: Definition& Relevance • Importance of nature & nurture in Personality Development • Importance and Recognition of Individual differences in Personality • Accepting and Managing Individual differences Intuition, Judgment, Perception & Sensation (MBTI) BIG5 Factors	
Unit-II- Managing Diversity	**5 hrs**
• Defining Diversity • Affirmation Action and Managing Diversity • Increasing Diversity in Work Force • Barriers and Challenges in Managing Diversity	
Unit-III- Socialization, Patriotism and National Pride	**5 hrs**
• Nature of Socialization • Social Interaction • Interaction of Socialization Process • Contributions to Society and Nation • Sense of pride and patriotism • Importance of discipline and hard work • Integrity and accountability	
Unit-IV- Human Rights, Values and Ethics	**4 hrs**
• Meaning and Importance of human rights • Human rights awareness • Values and Ethics- Learning based on project work on Scriptures like- Ramayana, Mahabharata, Gita etc.	

List of Professional Skill Development Activities (PSDA):

- Project on Understanding Diversity
- Term Paper on Patriotism among Youth

Course Learning Outcomes: On completion of the course:

- To recognize individual differences
- To manage individual differences
- To develop patriotic feelings
- To recognize their self in relation to society & nation

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Department of English, University of Delhi	The Individual & Society	Pearson Education	2010	9788131704172	266
Umang Malhotra	Individual, Society, and the World	iUniverse	2004	9780595662401	188
Tonja R. Conerly & Kathleen Holmes	Introduction to Sociology 3e	Openstax	2015	9781711493978	458
Daksh Tyagi	"A Nation of Idiots"	Every Protest	2019	9788194275015	350

French Grammar

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

French Grammar	Teaching Hours
Unit I: My Family and My House	**4 hrs**
Descriptors/Topics • Talk about your family members • Usage of possessive adjectives • Describe your house/apartment • Prepositions of location • Negation	
Unit II: Lifestyle	**3 hrs**
Descriptors/Topics • Talk about your hobbies and pastimes • Usage of appropriate articles : definite and contracted • Talk about your daily routine • Usage of pronominal verbs	
Unit III: In the City	**3 hrs**
Descriptors/Topics • Filling up a simple form • Ask for personal information • Usage of interrogative adjectives • Give directions about a place • Ordinal numbers • Usage of demonstrative adjectives	
Unit IV: Week-End	**3 hrs**
Descriptors/Topics • Talk about your week-end plans • Usage of disjunctive pronouns • Usage of Near Future tense • Talk about weather • Write a simple post card	

Course Learning Outcomes: At the end of this course, the students will be able to interact in a simple wayon everyday topics. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course,the student shall be able to:

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context

- Analyze and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Christine Andant, Catherine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1, Livre de l'élève et Cahier d'exercices.	Langers International Pvt. Ltd.	2010	9789380809069	---
Collins Dictionaries	Easy Learning French Complete Grammar, Verbs and Vocabulary	Collins	2016	9780008141721	---
Nikita Desai, Samapita Dey Sarkar	Apprenons La Grammaire Ensemble - French	Langers International Pvt. Ltd.	2017	9788193002681	---

German Grammar

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

German Grammar	**Teaching Hours**
Unit I: Time (Uhrzeit); People and the World: Land, Nationalität und Sprache	**5 hrs**
• Introduction of time • Read text related to time and teach the students the time expressions • Exercises related to Time • Adverbs of time and time related prepositions • Vocabulary: Countries, Nationalities, and their languages • Negation: “nicht/ kein” • Ja/Nein Fragen. • All the colors and color related vocabulary, adjectives, and opposites • Exercises and comprehension for the same	
Unit II: Irregular verbs (unregelmässige Verben)	**4 hrs**
• Introduction to irregular verbs and their conjugation e.g. fahren, essen, lesen etc • Read a text related to the eating habits of Germans • Vocabulary: Obst, Gemüse, Kleiderstück with usage of irregular verbs • Free time and hobbies • Food and drinks	
Unit III: Accusative case: articles and pronouns (Akkusativ Kasus: Artikel und Pronomen)	**4 hrs**
• Introduction to the concept of object (Akkusativ) • Formation of sentences along with the translation and difference between nominative and accusative articles • Usage of accusative Definite articles • Usage of accusative Indefinite articles	
Unit IV: Accusative case: possessive pronouns (Akkusativ Kasus: Possessivpronomen) Family and Relationship	**5 hrs**
• Accusative Personal Pronouns: - Revision of the nominative personal pronouns and introduction of accusative. Applicability of pronouns for both persons and things. • Usage of accusative Personal Pronouns • Introduction of accusative possessive pronouns • Difference between nominative and accusative possessive pronouns • usage of accusative possessive pronouns	

Course Learning Outcomes: After completing these modules, the students will be capable of constructing sentences with possessive and demonstrative adjectives in German. In addition, they will be proficient in formulating

meaningful sentences as they will be capable of applying their knowledge of all the irregularverbs they have learnt during the session. They will also have an idea of German culture by studying aboutvarious German festivals.

At the end of the course, the student shall be able to:

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context
- Analyse and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

Author	**Title**	**Publisher**	**Ed/year**	**ISBN No**	**Pages**
Dora Schulz, Heinz Griesbach	Deutsche Sprachlehre Fur Auslander	Max Hueber Verlag	1984	978-3190010066	---
Hartmut Aufderstrasse, Jutta Muller, Helmut Muller	Themen Aktuell: Glossar Deutsch	Max Hueber Verlag	2003	978-3190816903	---
Giorgio Motta	Wir Plus Grundkurs Deutsch fur Junge Lerner Book German Guide	Goyal Publishers	2011		248

Semester 3

B.Tech. Food Science Technology and Processing - 4 years (3rd Semester)

B. Tech. Food Science Technology and Processing				Semester 3					
S. No.	Course Code	Course Title	CourseType	Credits					Credit Units
				L	T	PS	FW	SW	
1		Applied Chemistry	Basic Science	3	0	1	0	0	4
2		Engineering Graphics & Drafting	Engineering Science	3	0	1	0	0	4
3		OOPs using C^{++}	Engineering Science	2	0	1	0	0	3
4		General Food Microbiology	Core course	3	0	1	0	0	4
5		Technology of Grain Processing	Core Course	3	0	1	0	0	4
6		Unit Operations in Food Processing	Core course	4	0	1	0	0	5
								Total credits	24

Applied Chemistry

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

Applied Chemistry	Teaching Hours
Unit I: Water Technology	**14 h**
Introduction and specifications of water, Hardness and its determination (EDTA method only), Alkalinity, Boiler feed water, boiler problems – scale, sludge, priming & foaming: causes & prevention, caustic embrittlement & corrosion: causes & prevention, Carbonate & phosphate conditioning, colloidal conditioning & calgon treatment, Water softening processes: Lime – soda process, Zeolite, Ion exchange method, Water for domestic use.	
Unit II: Fuels	**13 h**
Classification, calorific value of fuel, (gross and net), Determination of calorific value of fuels, bomb calorimeter, Solid fuels - Proximate and ultimate analysis, Numerical on combustion.	
Unit III: Instrumental Methods of analysis	**14 h**
Introduction; Principles of spectroscopy; Laws of absorbance, IR: Principle, Instrumentation, Application, UV: Principle, Instrumentation, Application, NMR: Principle, Instrumentation, Application	
Unit IV: Lubricants and Corrosion	**13 h**
Lubricants: Introduction; Mechanism of Lubrication; Types of Lubricants, Properties of lubricants; Viscosity and Viscosity Index; Iodine Value; Aniline Point; Emulsion number; Flash Point; Fire Point; Drop, Point; Cloud Point; Pour Point. Corrosion: Introduction, Mechanism of dry and wet corrosion, Types of corrosion-Galvanic, Concentration cell, soil, pitting, intergranular, waterline. Passivity, Factors influencing corrosion, Corrosion control	

List of Experiments: (Time: 36 hours)

List of Experiments:

1. To determine the ion exchange capacity of a given cation exchanger.
2. To determine the temporary, permanent, and total hardness of a sample of water by complexometric titration method.
3. To determine the type and extent of alkalinity of given water sample.
4. Determination of amount of oxalic acid and H_2SO_4 in 1 L of solution using N/10 NaOH and N/10 $KMnO_4$ solution.
5. To prepare and describe a titration curve for phosphoric acid – sodium hydroxide titration using pH-meter.
6. To find the cell constant of conductivity cell.
7. Determine the strength of hydrochloric acid solution by titrating it against standard sodium hydroxide solution conductometrically.
8. Determination of Dissolved oxygen in the given water sample
9. To determine the total residual chlorine in water.
10. Determination of viscosity of given oil by means of Redwood viscometer I.
11. To determine flash point and fire point of an oil by Pensky Martin's Apparatus.

Course Learning Outcomes:

The student will be able to

1. Apply the knowledge of water treatment processes for water quality monitoring.
2. Calculate the calorific value based on fuel composition
3. Propose a suitable control method to combat corrosion in daily life
4. Choose lubricants based on their properties for a particular application.
5. Interpret the structure of molecules based on the spectral data.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
V. K. Ahluwalia,	Comprehensive Experimental Chemistry.	New Age Publication, Delhi.	1997	9788122410655	376
Sunita Rattan	Experimentsin Applied Chemistry	Kataria & Sons	2011	9788188458059	400

OOPs using C++

L	T	P	Total Credits
2	0	1	3

Course content and syllabus

OOPs using C++	Teaching Hours
Unit I: Introduction	**9 hrs**
Difference between C and C++, Procedure Oriented and Object-Oriented Approach, Basic Concepts: Objects, classes, Principals like Abstraction, Encapsulation, Inheritance and Polymorphism. Dynamic Binding, Message Passing, Characteristics of Object-Oriented Languages	
Unit II: Classes & Objects	**9 hrs**
Abstract data types, Object & classes, attributes, methods, C++ class declaration , Local Class and Global Class, State identity and behaviour of an object , Local Object and Global Object, Scope resolution operator, Friend Functions, Inline functions, Constructors and destructors, instantiation of objects, Types of Constructors, Static Class Data, Array of Objects, Constant member functions and Objects, Memory management Operators	
Unit III: Inheritance and Polymorphism	**9 hrs**
Inheritance, Types of Inheritance, access modes – public, private & protected, Abstract Classes, Ambiguity resolution using scope resolution operator and Virtual base class, Aggregation, composition vs classification hierarchies, Overriding inheritance methods, Constructors in derived classes, Nesting of Classes. Polymorphism, Type of Polymorphism – Compile time and runtime, Function Overloading, Operator Overloading (Unary and Binary), Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, Pure virtual functions.	
Unit IV: Strings, Files and Exception Handling	**9 hrs**
Manipulating strings, Streams and files handling, Formatted and Unformatted Input output Exception handling Generic Programming – function template, class Template Standard Template Library: Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, the Container Classes.	

List of Experiments: (Time: 36 hours)

List of Experiments:

1) Creation of objects in programs and solving problems through them
2) Different use of private, public member variables and functions and friend functions.
3) Use of constructors and destructors.
4) Operator overloading
5) Use of inheritance in and accessing objects of different derived classes.
6) Polymorphism and virtual functions (using pointers).
7) File handling

Course Learning Outcomes:

The student will be able to

- Articulate the principles of object-oriented problem solving and programming.
- Outline the essential features and elements of the C++ programming language.
- Explain programming fundamentals, including statement and control flow and recursion.
- Apply the concepts of data abstraction, function abstraction, inheritance, overriding, overloading, and polymorphism.
- Apply the concepts using objects and data abstraction, class, and methods in function abstraction.
- Analyze, write, debug, and test basic C++ codes using the approaches introduced in the course.
- Analyze problems and implement simple C++ applications using an object-oriented software engineering approach.

Text / Reference Books:

Author	**Title**	**Publisher**	**Ed/year**	**ISBN No**	**Pages**
A.R. Venugopal, Rajkumar, T. Ravishanker	Mastering C++	TMH	1997	978-0074634547	804
R. Lafore	Object Oriented Programming using C++	BPB Publications	2004	978-8131722824	1040
Schildt Herbert	C++: The Complete Reference	Wiley DreamTech	2005	978-0070411838	832

Fundamentals of Python

L	T	P	Total Credits
2	0	1	3

Course content and syllabus

Fundamentals of Python	Teaching Hours
Unit I: Introduction and basic programming with Python	**9 hrs**
History of Python, Need of Python Programming, Applications, Basics of Python Programming, Running Python Scripts, Installation of Jupyter Notebook, Variables, Assignment, Keywords, Input-Output, statement, Indentation, comments.	
Unit II: Datatypes and Operators	**9 hrs**
Datatypes :- Integers, Strings, Booleans; Operators- Arithmetic, Comparison (Relational), Assignment, Logical, Bitwise, Membership, Identity, Operator Precedence.	
Unit III: Control Flows and Loops	**9 hrs**
Control Flows and conditional statements in Python- if, if-elif-else, break, continue, loops, types of loops: for, while.	
Unit IV: Python Strings, Lists, Tuples, Sets, Dictionary	**9 hrs**
Strings, Lists - Operations, Slicing, Methods; Tuples: Creating, Printing, properties oftuples, Sets, Dictionaries, Sequences and their properties.	

List of Experiments: (Time: 36 hours)

List of Experiments:

1) Perform installation of python, of jupyter notebook
2) Execute a basic python program with a print message.
3) WAP to Check the Python version on command line
4) WAP to display the current date and time.
5) WAP to get Multiple inputs From a User in One Line.
6) WAP which accepts the user's first and last name and print them in reverse order with a spacebetween them.
7) WAP to implement show Operators Precedence and different types of operators.
8) WAP to declare, access and print a dictionary
9) WAP to check whether a given key already exists in a dictionary.
10) WAP to declare, access and print a list with 10 elements
11) WAP to declare, access and print a tuple.
12) WAP to declare, access and print a set of values.

Course Learning Outcomes:

The student will be able to

- Understand the basics of programming and implement basic python programs, input output functions, datatypes.
- Learn the use of various types of operators and their precedence.
- Develop programs using conditional statements and branching.
- Implement the concept of control flows and iterations in python programs.
- Develop an application using the fundamentals of list, dictionary, tuples and solve scientific problems.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No
Paul Barry	Head First Python	O'Reilly Media, Inc.	2016	9781491919538
Mark Lutz, David Ascher	Learning Python	O'Reilly	2007	978-9351102014
Kenneth A. Lambert	Fundamentals of Python	Cengage	2019	9789353502898

General Food Microbiology

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

General Food Microbiology	Teaching Hours
Unit I: Introduction, History and Basic Principles of Microbiology	**13 hrs**
Definition and scope of food microbiology. Inter-relationship of microbiology with other sciences. **Historical perspective:** Contributions of Nobel Laureates and other scientists in discovering microorganisms and their roles in human lives; spontaneous generation Vs biogenesis theory, germ theory of disease. Emergence of food microbiology. **Basic Principles**: Diversity and classification of food microbes. Culture media, culture maintenance and preservation. Sterilization Techniques.	
Unit II: Principles Underlying Microbial Growth in Food Systems	**14 hrs**
Microbial Growth and Metabolism Types: Concept of microbial growth, growth curve, growth and death kinetics, mathematical expression of growth. Microbial metabolism: Phototroph, chemolithotroph, anaerobic respiration, fermentation, methanogenesis, nitrogen fixation. **Growth in Food Systems**: Sources of microbial contamination of foods. Fitness and unfitness of foods for consumption. Factors affecting growth and diversity of microorganisms in foods. Inherent growth-inhibitory characteristics of food products.	
Unit III: Food Spoilage and Enumeration of Food Pathogens	**13 hrs**
Food spoilage: spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products. **Enumeration**: Pure culture techniques. Methods of isolation and cultivation of food pathogens. Challenges in microbiological analysis of foods. Qualitative and quantitative methods for detection of spoilage-causing microbes	
Unit IV: Microbial Toxins and Food Borne Diseases	**14 hrs**
Toxins from microbes: Toxins from food pathogens; *Staphylococcus*, *Salmonella*, *Shigella*, *Escherichia*, *Bacillus*, *Clostridium*, and *Aspergillus* genera. **Food Borne Diseases**: Food infections, food intoxications, food toxi-infections. Epidemiology, symptoms, pathophysiology, morbidity and mortality of food-borne diseases.	

List of Experiments: (Time: 36 hours)

1) Laboratory safety and instrumentation.
2) Preparation of culture media and sterilization.
3) Isolation of microorganisms from finished and spoiled food products: Streak plate method, spread plate method, Serial dilution and pour plate method.
4) Staining techniques: Simple staining, Gram staining, negative staining.
5) Biochemical tests –Indole test. Methyl red test. Voges Proskauer test, Citrate utilization test (IMViC), starch hydrolysis test, catalase test.
6) Generation of bacterial growth curve.
7) Antibiotic susceptibility testing.

Course Learning Outcomes:

The student will be able to:

1. Discuss the history and contribution of different scientists to the field of microbiology, about interrelated links between microbiology and nature, and how microbiology shaped the renaissance of modern-day society. Define the concept of culturing, preserving and controlling microbial growth preservation, sterilization.
2. Describe the concepts of microbial growth and metabolism and detailing food-related conditions for survival and growth of food microbes.
3. Discuss about types of spoilages in food products and enumeration of food pathogens.
4. Elaborate the toxins produced by potential food pathogens and their respective diseases, along with an account of epidemiology, symptoms and pathophysiology. Expand and justify further study, teaching, research and employment in microbial research or the practical applications of food microbiology

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Willey, Sherwood, Woolverton	Prescott, Harley and Klein's Microbiology 7th edition	McGraw Hill Higher Education	2011	978-0697013729	1056
Madigan, Martinko, Stahl, Clark	Brock Biology of Microorganisms, 13thedition	Benjamin Cummings.	2013	978-9332586864	1024
Frazier WC, Westoff DC	Food Microbiology 4th Ed.,	Tata Mc Graw Hill Publ. Co. Ltd	2014	9781259062513	492
Jay JM	Modern Food microbiology, 3rd Ed.,	Van No Strand Reinhold Co. Inc.	2005	9780387231808	790
K R Aneja	Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 5th Edition	New Age International Publishers, London, New Delhi, Nairobi	2018	978-93-86418-30-2	580

Technology of Grain Processing

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

Technology of Grain Processing	Teaching Hours
Unit I: Wheat: Structure, Composition and Processing	**14 hrs**
Wheat: Production, composition, structure and characteristics of varieties, classification and properties, criteria of grain and flour quality, wheat conditioning and milling, air classification of flour, Flour and its treatment, rheology and chemistry of dough, physical dough testing instruments. Durum wheat and pasta products like macaroni, noodles and sphagatti. Processing of wheat flakes.	
Unit II: Rice: Structure, Composition and Processing	**13 hrs**
Rice: Production, composition, structure and characteristics of varieties, classification, and properties, milling, criteria of rice quality and parboiling of paddy, processed foods from rice, rice milling, Machinery and modern rice mill, stabilization of rice bran, by products of rice milling and their uses specifically rice bran oil.	
Unit III: Corn: Structure, Composition and Processing	**14 hrs**
Corn: Production, corn type, composition, structure and characteristics of varieties, dry and wet milling of corn, composition and properties of corn starch, corn based ready- to-eat breakfast cereals, alkaline cooked products, tortillas, nixtamalized corn flours, snacks from corn, tortilla chips, extruded snacks, Corn oil, corn starch, glucose syrup, high fructose corn syrups, dextrose and maltodextrin.	
Unit IV: Pulses and Oilseeds: Composition and Processing	**13 hrs**
Pulses: Pulse Production and consumption trend, minor and major constituents, antinutritional factors. Criteria of pulse quality, methods of protein isolates and protein concentrates preparation, functional properties of protein isolates and concentrates, pulse products (canned, germinated, extruded)	

List of Experiments: (Time: 36 hours)

1. Evaluation of grain characteristics of wheat, rice, and corn.
2. Experimental milling of wheat.
3. Evaluation of quality characteristics of wheat flour.
4. Isolation of gluten and starch from wheat.
5. Milling of rice and evaluation of head rice yield, physicochemical-cooking quality of rice.
6. Experiment on parboiling, evaluation of quality.
7. Evaluation of color and texture characteristics of brown, white and parboiled rice.
8. Experimental milling of corn and evaluation of flour yield.
9. Alkaline corn product preparation
10. Evaluation of the quality of alkaline corn products like tortilla, chips, and taco shells.

Course Learning Outcomes:

- Comprehend the structure and composition of cereals.
- Understand the processes for the preparation of various types of products from cereals.
- Identify suitable equipments required for processing of cereals.
- Comprehend the detailed manufacturing technologies of cereals consumed in daily life in food industries.

Text / Reference Books:

Text / Reference Books:					
Author	**Title**	**Publisher**	**Year of publication**	**ISBN**	**Pages**
Chakraverty.	Post-Harvest Technology of Cereals, Pulses and Oilseeds,	Oxford & IBH Publishing Co. Pvt Ltd.	2019	9788120409699	368
Kent, N.L.	Technology of Cereal, 5th Ed.	Pergamon Press.	2000	9781855733619	352
Marshall.	Rice Science and Technology	Wadsworth Ed. New York: Marcel Dekker.	1993	9780824788872	486
Sergio Serna-Saldivar	Corn Chemistry and Technology, 3rd Edition	Woodhead Publishing and AACC International	2018	9780128118863, 9780128119716	690
Fereidoon Shahidi; Alton Edward Bailey	Bailey's industrial oil and fat products	Wiley-Interscience,	2005	9780471384601	3616
B. Tiwari and N. Singh	Pulses Chemistry and Technology	Cambridge, UK : RSC Pub	2012	9781849733311	310

Unit Operations in Food Processing

L	T	P	Total Credits
4	0	1	5

Course Contents/Syllabus:

Unit Operations in Food Processing	Teaching hours
Unit I: Introduction to material handling	**18 hrs**
Material handling – theory, classification of various material handling equipments – conveyors (gravity and powered conveyors), elevators (bucket and screw type elevators), pneumatic conveyors; Cleaning – types of contaminants, methods of cleaning- dry cleaning methods: screening, aspiration, magnetic cleaning and abrasive cleaning, wet cleaning methods: soaking, spray washing, flotation washing and ultrasonic washing, combination methods.	
Unit II: Sorting and grading	**18 hrs**
Sorting and grading: advantages, methods; Size reduction- benefits, forces, criteria, energy requirement by Rittinger law, Kick's law, Bond's law, mode of operation of size reduction equipment – open circuit and closed circuit grinding, free crushing, choke feeding and wet milling; Size reduction of solid foods, fibrous foods and liquid foods; Effects of size reduction on solid and liquid foods; Sieving- terminology, effectiveness of screen, particle size analysis, fineness modulus, equipments.	
Unit III: Mixing- terminology, equipments	**18 hrs**
Mixing- terminology, equipments – mixers for liquids of low or moderate viscosity (Paddle agitators, turbine agitators and propeller agitators), mixers for high viscosity pastes (pan mixer, horizontal mixer and dough mixer), mixers for dry solids (tumbler mixer & vertical screw mixer), effects of mixing on foods; Filtration- terminology (feed slurry, filtrate, filter medium, filter cake and filter); Methods/equipments: pressure filtration, vacuum filtration and centrifugal filtration; Expression- factors affecting efficiency, methods of expressing the liquid from solid-liquid food system – hydraulic pressing, roller pressing and screw pressing;	
Unit IV: Evaporation	**18 hrs**
Evaporation- functions, factors affecting the rate of heat transfer, factors influencing the economics of evaporation, equipments – open pans, horizontal tube, vertical tube and plate evaporator, single and multiple effect evaporators; Dehydration- objectives, terminology, basic theory, drying curves; Dehydration systems- Tray drier, tunnel drier; Drying time calculations; Freeze drying- conventional drying vs. freeze drying, equipments used.	

List of Experiments: **(Time: 36 hours)**

Course Learning Outcomes:

1. Develop the understanding of material handling.
2. Understand the processing of foods in terms of common unit operations like size reduction, mixing, and separation.
3. Apply his computational skills in calculating the energy required in size reduction, dehydration.
4. Understand the construction, working and applicability of various size reduction, mixing and separation equipments.
5. Able to understand the principle and application of dehydration and freezing.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages

Earle R. L.	Unit Operations in Food Processing, 2nd Edition,	Elsevier Science	2013	9781483293103,	216
Singh R. P. & Heldman D. R.	Introduction to Food Engineering	Academic Press.	2001	9780080574493,	750
Toledo R. T.	Fundamentals of Food Process Engineering,	Springer US	2012	9781461570578,	602

Semester 4

B.Tech. Food Science Technology and Processing - 4 years (4th Semester)

B. Tech. Food Science Technology and Processing				Semester 4					
S. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1		Thermodynamics	Basic Sciences	4	0	0	0	0	4
2		Fluid Mechanics	Engineering Science	2	0	0	0	0	2
3		Fruits and Vegetables Processing	Core course	3	0	1	0	0	4
4		Principles of Food Engineering	Core course	4	0	0	0	0	4
5		Principles and Methods of Food Processing	Core Course	3	0	0	0	0	3
6		Fermentation Technology	Core Course	3	0	0	0	0	3
7		Personal Finance and Planning	HSSMC	4	0	0	0	0	4
				Total credits					24

Thermodynamics

L	T	P	Total Credits
4	0	0	4

Course Contents/Syllabus:

	Teaching hours
Unit I: Basic Concepts	**18 hrs**
Basic Concepts Continuum and macroscopic approach; thermodynamic systems (closed and open); thermodynamic properties and equilibrium; state of a system, state postulate for simple compressible substances, state diagrams, paths and processes on state diagrams; concepts of heat and work, different modes of work; zeroth law of thermodynamics; concept of temperature. **First Law of Thermodynamics:** Concept of energy and various forms of energy; internal energy, enthalpy; specific heats; first law applied to elementary processes, closed systems and control volumes, steady and unsteady flow analysis.	
Unit II: Second Law of Thermodynamics	**18 hrs**
Second Law of Thermodynamics: Limitations of the first law of thermodynamics, concepts of heat engines and heat pumps/refrigerators, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Carnot cycle and Carnot principles/theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; microscopic interpretation of entropy, the principle of increase of entropy, T-s diagrams; second law analysis of control volume; availability and irreversibility; third law of thermodynamics.	
Unit III: Properties of Pure Substances & Thermodynamic Relations	**18 hrs**
Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-v-T behaviour of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, ideal gas equation of state and van der Waals equation, **Thermodynamic Relations** T-ds relations, Helmholtz and Gibbs functions, Gibbs relations, Maxwell relations, Joule-Thomson coefficient, coefficient of volume expansion, adiabatic and isothermal compressibility, Clapeyron and Clapeyron-Clausius equations. **Thermodynamic Cycles:** Carnot vapor cycle, ideal Rankine cycle, Rankine reheat cycle, air-standard Otto cycle, air-standard Diesel cycle, air-standard Brayton cycle, vapor-compression refrigeration cycle.	
Unit IV: Ideal and Real Gases	**18 hrs**
Ideal and Real Gases: concept of an ideal gas, basic gas laws, characteristic gas equation, Avogadro's law and universal gas constant, P-V-T surface of an ideal gas; Vander Waal's equation of state, reduced co- ordinates, compressibility factor and law of corresponding states; Mixture of gases, mass, mole and volume fraction, Dalton's and Amagat's laws, properties of ideal gas mixtures, air-water vapor mixtures and simple thermodynamic processes involving them; specific and relative humidities, dew point and wet bulb temperature, adiabatic saturation temperature, psychrometric chart.	

Course Learning Outcomes:

1. Grasp the basic concept of thermodynamic system.
2. Understand the laws of thermodynamics
3. Comprehend the principles of engine systems.
4. Understand the properties of pure substances and real gases.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Page
Jones & Dugan	Engineering Thermodynamics,	Prentice Hall of India.	1995	978-0023613326	500
Radhakrishnan E.	Fundamentals of Engineering Thermodynamics, 2nd edition,	Prentice Hall of India.	2006	978-8120327900	716
Rao Y. V. C.	Theory and Problems of Thermodynamics	Wiley Eastern Limited	1994	8122406599, 9788122406597	423
Arora C. P.	Thermodynamics,	McGraw Hill Education	2014	978-0074620144	762
Nag P. K.	Engineering Thermodynamics,	Tata McGraw Hill.	2005		

Fluid Mechanics

L	T	P	Total Credits
2	0	0	2

Course content and syllabus

Fluid Mechanics	Teaching Hours
Unit I: Introduction	**9 hrs**
Basic concepts of fluid mechanics. Fundamental terms. Physical values. Fluids and their properties. Forces inside fluid, Pascal's law. Euler's equation of fluid statics. Measurement of pressure.	
Unit II: Fluid Statistics and Kinematics	**9 hrs**
Relative statics of fluid – constant acceleration, rotation. Forces of hydrostatic pressure. Buoyancy. Flotation. Stability. Euler and Lagrangian specification of fluid flow. Streamlines. Path lines. Stream surface. Stream tube. Mass/volume flow. Control volume	
Unit III: Fluid Dynamics	**9 hrs**
Continuity equation. Basic laws of fluid dynamics – conservation of mass, conservation of linear momentum, conservation of energy. Ideal fluid flow. Application of Bernoulli's equation. Real fluid flow. Viscosity. Determination of losses. Reynolds experiment. Laminar and turbulent flow. Boundary layer. Velocity profile. Losses in pipes. Frictional losses. Nikuradse experiments. Moody's diagram. Local losses. Coefficients of resistance.	
Unit IV: Hydraulic Design of Pipeline	**9 hrs**
Different approaches in designing the pipeline– pressure drop, mass/volume low, diameter of pipeline. Graphical view. Energy properties of pumps and hydraulic machines. Dimensional analysis. Theory of similarity. Flow of fluid in open channels. Non- stationary flow and hydraulic shock.	

Course Learning Outcomes:

The student will be able to:

1. Define basic terms, values and laws in the areas of fluids properties, statics, kinematics and dynamics of fluids, and hydraulic design of pipes,
2. Describe methods of implementing fluid mechanics laws and phenomena while analysing the operational parameters of hydraulic problems, systems and machines.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Granger, R.A	Fluid Mechanics	Dover Publications, New York	2nd ed./1995	9780486683560	928
Douglas, J.F. Gasiorek, J.M. Swaffield, J.A	Fluid Mechanics	Prentice Hall, NJ	5th ed./ 2005	0131292935	-

Fruits and Vegetables Processing

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Fruits and Vegetables Processing	Teaching hours
Unit I: Definition, classification and development of fruits and vegetables	**14 h**
Scope of fruit and vegetable processing industry in India - present status, constraints and prospects. Definition of fruits and vegetables – classification, types and importance in our diet. Structure and composition of fruits and vegetables - chemical composition and nutritive value, pre-harvest factors affecting post-harvest quality of fruits and vegetables. **Physiological development** – fruit ripening, respiration, role of ethylene, fruit Maturity - Definition, methods of maturity determination, maturity indices for selected fruits and vegetables. Chemical changes during maturation.	
Unit II: Principles and preservation methods of fruits and vegetables	**13 h**
Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables. **Methods of storage**- controlled atmospheric storage (CAS), modified atmospheric storage (MAS) and Hypobaric. **Minimal processing of fruits and vegetables**; Blanching- operations and equipment **Canning**: Definition, processing steps, and equipment; Cans and containers, quality assurance and defects in canned products	
Unit III: Equipments in Fruits and Vegetable Processing	**14 h**
FSSAI specifications and processing technology of jam, jelly and marmalades, role of pectin and theories of gel formation, fruit preserves and candied fruits, chutneys, pickles, pickling with vinegar and fermentation – sauerkraut, sauces and ketchups. **Technology of mushroom**: production, processing and its processed products	
Unit IV: Processing technology of fruit beverage	**13 h**
FSSAI specifications and processing technology of fruit beverage - unit operations involved in preparation of fruit beverage, types of beverages, processing technology of beverages- juice, ready to serve (RTS), nectar, cordial, squash, crush, processing of syrups, fruit juice concentrate, fruit juice powder, carbonated beverages, fruit cheese, fruit leather Utilization and disposal of fruit and vegetable industry wastes	

List of Experiments: (Time: 36 hours)

1. Estimation of total soluble solids, pH, acidity, brix to acidity ratio, ascorbic acid in food
2. Canning of selected vegetables and fruits
3. Making and evaluation of pectin and tomato products.
4. Drying and rehydration of fruits and vegetables.
5. Extraction and estimation of polyphenol content and antioxidant activity in selected fruits and vegetables
6. Preparation of jam and jelly from selected fruits
7. Preparation of squash/ crush

8. Preparation of pickles
9. Dehydration of ginger, onion and garlic
10. Preparation of candied fruit and glazed fruit

Course Learning Outcomes:

- Gaining knowledge about the significance of fruits and vegetable in human health
- Understanding about the preservation of fruits and vegetables by caning, drying and other methods
- Learning about methods of making fruit beverages, sterilization methods, and packaging
- Gaining in-depth knowledge of drying vegetables and fruits by different methods, and storage.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Thompson, A.K.,	Fruits and vegetables; Harvesting, handling and storage.	Blackwell Publishing.	2003	9781118654040	--
Crusess, W.B.	Commercial fruit and Vegetable Products.	W.V. Special Indian Edition. Agrobios India.	2004	9788177540413	906
Ranganna S.	Handbook of analysis and quality control for fruits and vegetable products.	Tata Mc Graw-Hill publishing company limited, Second edition.	1986	9780074518519	1112

Principles of Food Engineering

L	T	P	Total Credits
4	0	0	0

Course Contents/Syllabus:

Principles of Food Engineering	Teaching hours
Unit I: Introduction to Food Engineering	**18 h**
Introduction to Food Engineering: units and dimensions; Material and energy balance: basic principles, process flow diagrams, total mass balance, component mass balance **Momentum transfer:** Flow rate and pressure drop relationships for Newtonian fluids flowing through pipe, Reynolds number. problems related to material balance, heat balance and energy balance.	
Unit II: Fluid Flow Principles and mechanical operations	**18 h**
Fluid Flow Principles: fluid statics and fluid dynamics, Bernoulli equation, streamline and turbulent flow, fluid flow applications, measurement of pressure and velocity, **Mechanical operations:** size reduction of solids, high pressure homogenization, filtration, centrifugation, settling, sieving, mixing & agitation of liquid.	
Unit III: Heat and mass transfer in foods	**18 h**
Heat transfer: heat transfer by conduction, convection, radiation, heat exchangers. **Mass transfer:** Mass transfer operations: psychometric, humidification and dehumidification operations. molecular diffusion and Flick's law, conduction and convective mass transfer, permeability through single and multilayer films. **Thermal Process Calculations:** Commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of microorganisms, thermal process calculation for canned foods, calculation of processing time in continuous flow systems. Boiler design, working; Steam properties. **Thermal operations:** Sterilization, evaporation of liquid foods: types, hot air drying of solids, spray drying. advantages and disadvantages of thermal drying operations.	
Unit IV: Cold preservation of food products	**18 h**
Refrigeration: introduction, refrigeration cycle, components of refrigeration systems: compressor, condenser, and expansion valve, mechanical refrigeration system, Freezing time calculations; freezing and crystallization, freeze-drying. **Liquid transport system:** pipelines and pumps for food processing plants, types of pipelines, positive displacement pumps, air-lift pumps, propeller pumps, centrifugal pumps and jet pumps, pump selection.	

Course Learning Outcomes:

1. Understand various basic aspects of food engineering.
2. Grasp the knowledge about fluid flow of foods.
3. Comprehend the thermal process calculations.

4. Understand the processing of foods by thermal and freezing process.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Earle, R.L.	Unit Operations in Food Processing, 2nd edition.	Pergamon press.	1989	9780080255361	207
Fellows, P.	Food processing technology.	Woodhead publication, 3rd edition	2022	9780323857376	962
Rao, D.G.	Fundamentals of food engineering	PHI learning private ltd.	2010	9788120338715	614
Singh, R.P and Heldman DR.	Introduction to food engineering. 5th edition.	Academic press.	2014	9780123985309	867
Toledo Romeo T.	Fundamentals of Food Process Engineering	Aspen Publishers	1999	9783030079338	465

Principles and Methods of Food Processing

L	T	P	Total Credits
3	0	0	3

Course Contents/Syllabus:

Principles and Methods of Food Processing	Teaching hours
Unit I: High temperature processing	**14 h**
Introduction to food processing: basic principles, importance of food processing and preservation; classification of foods, types of food spoilage, viz. microbiological, enzymatic, chemical, physical and their effects on food quality. **High temperature processing:** principles of thermal processing, pasteurization and sterilization, batch and continuous sterilization; Thermal Death Time (TDT) curve; ultra heat treatment UHT processing.	
Unit II: Industrial Food Processing Operations	**13 h**
Industrial applications of canning and bottling: commercial canning operation, spoilage of canned food and its quality evaluation; food irradiation; application of ultraviolet (UV) rays in food, microwave heating, its mechanism, effects and applications in food preservation. Hurdle technology,	
Unit III: Low temperature processing	**14 h**
Low temperature processing: low temperature requirement for different foods, refrigeration, freezing principles, freezing rate, estimation of freezing time of foods, chilling and freezing of food, freezing process, determining freezing load, low and fast freezing, refrigeration systems and types of freezers, thawing of frozen food, advantages of cold preservation. principles of freeze concentration	
Unit IV: Preservation by moisture removal	**13 h**
Processing by moisture removal: evaporation, concentration and dehydration, drying operation, types of dryers, their advantages and disadvantages, concentration of liquid food by evaporators, continuous, multiple effect, falling and rising film evaporators, membrane processes for liquid food concentration; **Water activity (a_w) in foods:** role of water activity in food preservation, control of a_w by addition of solutes and moisture removal, moisture sorption isotherm, measurements of water activity; intermediate moisture food (IMF), Use of preservatives: Sugar and salt preservation, use of chemical preservatives in food, smoking, sulphur fumigation and pickling, purposes and advantages.	

Course Learning Outcomes:

1 Understand the processing and spoilage of food product.

2. Understand methods of inactivation of micro-organisms at high temperature.

3. Apprehend ways of restriction of growth of microorganisms at low temperature.

4. Perceive the role of water activity and its role to determine the shelf-life of various food products.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
G. Subbulakshmi	Food Processing and Preservation	New Delhi: New Age International	2017	8122412831, 978-8122412833	298
Manay, N S, and M Shadaksharaswamy	Foods: Facts and Principles,	New Delhi: New Age International Ltd.	2008	9788122422153, 8122422152	490
D. K. Salunkhe, S.S. Kadam	Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing	CRC Press	1998	9780824796433	611
Fellows, P.	Food Processing Technology, 2nd Edition.	Woodhead Publishing Limited and CRC Press LLC.	2000	9780323857376	962

Fermentation Technology

L	T	P	Total Credits
3	0	0	3

Course Contents/Syllabus:

Fermentation Technology	Teaching hours
Unit I: Introduction to fermentation technology	**13 h**
Introduction, history, scope and principal components of fermentation technology; Types of fermentation. Growth kinetics during fermentations; Isolation & screening of microorganisms used in fermentations; Media for industrial fermentation, criteria used in media formulation, sterilization, raw materials.	
Unit II: Types and designs of fermenters	**14 h**
Fermenter Design: bioreactor configuration, design features, criteria in Fermenter design, requirement for aeration and mixing, energy transfer; Other fermenter designs- tube reactors, packed bed reactors, fluidized bed reactors, cyclone reactors, trickle flow reactors; Measurement and control of fermentation parameters.	
Unit III: Types of fermentation systems	**13 h**
Fermentation Systems: Batch and Continuous system, Fed batch culture, solid substrate fermentation; Production and recovery of primary and secondary metabolites: industrial alcohol, citric acid, acetic acid, lactic acid, acetone- butanol fermentation, amino acids- lysine & glutamic acid production, enzymes, antibiotics (penicillin and tetracycline); oriental fermented foods vitamins.	
Unit IV: Downstream Processing of metabolites	**14 h**
Methods of separation, purification and formulation of metabolites; Principles of overproduction of primary and secondary metabolites with relevant examples; Application of fermentations for value- addition; Waste production, types utilization for production of useful products; Waste treatment systems, aerobic and anaerobic systems for wastes from industry.	

Course Learning Outcomes:

1. Understand the scope of fermentation technology in food industry.
2. Learn about parts, design and working of fermenters.
3. Describe about cultivation techniques of industrial microorganisms.
4. Learn about production of primary and secondary metabolites.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Brian, J. Wood.	Microbiology of Fermented Foods Volume I and II	Blackie Academic & Professional,	1998.	9780751402162	872

Stanbury, P.F., Whitekar A. and Hall	Principles of Fermentation Technology	Reed Elsevier India Pvt. Ltd.	2013	9780080999531	803
Pandey A.,	Current Developments in Biotechnology and Bioengineering: Current Advances in Solid-State Fermentation	Elsevier	2017	978-0444639905	278

Personal Finance and Planning

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

Personal Finance and Planning	Teaching Hours
Unit I: Introduction to Financial Planning	**18 h**
Financial goals, Time value of money, steps in financial planning, personal finance/loans, education loan, car loan & home loan schemes. Introduction to savings, benefits of savings, management of spending & financial discipline, Net banking and UPI, digital wallets, security and precautions against Ponzi schemes and online frauds such as phishing, credit card cloning, skimming.	
Unit II: Investment Planning; Personal Tax Planning	**18 h**
Process and objectives of investment, Concept and measurement of return & risk for various assets class, Measurement of portfolio risk and return, Diversification & Portfolio formation. Gold Bond; Real estate; Investment in Greenfield and brownfield Projects; Investment in fixed income instruments-financial derivatives & Commodity market in India. Mutual fund schemes including SIP; International investment avenues. Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads of income and gross total income. Comparison of benefits - Special provision u/s 115BAC vis-à-vis General provisions of the Income-tax Act, 1961, tax avoidance versus tax evasion.	
Unit III: Insurance Planning	**18 h**
Need for Protection planning. Risk of mortality, health, disability and property. Importance of Insurance: life and non-life insurance schemes. Deductions available under the Income-tax Act for premium paid for different policies.	
Unit IV: Retirement Benefits Planning	**18 h**
Retirement Planning Goals, Process of retirement planning, Pension plans available in India, Reverse mortgage, New Pension Scheme. Exemption available under the Income-tax Act, 1961 for retirement benefits.	

Course Learning Outcomes:

The student will be able to:

1. Understand the framework for financial planning to comprehend the overall role finances play in his/her personal life.
2. Apply economic models & decision-making framework to a range of managerial problems.
3. Analyze the comparative merits of savings & investment options in terms of risk, return and tax implications.
4. Evaluate savings and investment strategies to achieve financial goals.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Indian Institute of Banking & Finance	Introduction to Financial Planning	Taxmann Publication	2017	978-9386394552	392
Pandit, A.	The Only Financial Planning Book that You Will Ever Need	Network 18 Publications Ltd.	2014	978-9380200606	230
Sinha, M.	Financial Planning: A Ready Reckoner	McGraw Hill Education	2008	978-9385965562	288
Halan, M.	Let's Talk Money: You've Worked Hard for It, Now Make It Work for You.	HarperCollins Publishers.	2018	978-9352779390	204
Tripathi, V.	Fundamentals of Investment	Taxmann Publication	2017	9789390609093	628

Semester 5

B.Tech. Food Science Technology and Processing - 4 years (5th Semester)

B. Tech. Food Science Technology and Processing				Semester 5					
S. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1		Technology of Dairy Products Processing	Core Course	3	0	1	0	0	4
2		Instrumental Analysis of Food	Core Course	4	0	0	0	0	4
3		Statistical Quality Control for Food Industry	Core Course	3	0	1	0	0	4
4		Engineering Graphics & Drafting	Engineering Course	3	0	0	0	0	3
5		Professional Ethics	Value Added Course	2	0	0	0	0	2
6		*Students will choose anyone course** 1) Technology of Fats and Oils 2) Technology of Beverages	Specialization Elective Course	3	0	0	0	0	3
7		Entrepreneurship and New Venture Creation	Employability/Skill Enhancement	4	0	0	0	0	4
				Total credits					**24**

Technology of Dairy Products Processing

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Technology of Dairy Products Processing	Teaching hours
Unit I: Milk properties and Composition	**14 h**
Current status of Indian dairy sector: production, utilization and per capita consumption of milk; Milk: definition, types of milk, composition, nutritive value of milk and milk products; Milk properties: physical, chemical and thermal properties like density, acidity, redox potential, specific gravity, thermal conductivity; Milk processing: reception, pasteurization (LTLT, HTST), homogenization, sterilization, aseptic packaging.	
Unit II: Milk product processing and preservation	**13 h**
Milk processing: reception, pasteurization (LTLT, HTST), pasteurizer, homogenization, sterilization, aseptic packaging., Special Milks, Toned milk, Double Toned Milk, Recombined Milk, Fermented Milks Cream separation, equipment used, Butter: definition, butter-making process, overrun, defects in cream & butter. Technology of ice-cream: composition of ice-cream, methods of preparation	
Unit III: Processing of Cheese and indigenous Dairy products	**14 h**
Cheese: technology of different varieties of cheese manufacturing (cheddar & mozzarella), changes during ripening, manufacture of processed cheese, defects in cheese. Dried milks: dried whole milk, dried non-fat milk/SMP, milk drying system (film, roller, drum, spray, foam spray drying). Evaporated and concentrated milks: water and solid balance, boiling point elevation Introduction to traditional dairy products: Rabri, kulfi, srikhand, mawa, Chenna, paneer, ghee. Dahi	
Unit IV: Value addition to dairy products and by-products utilization	**13 h**
Value addition and by-products utilization: fortified milk and milk products such as minerals and vitamins fortified milk; Low fat, low lactose and low cholesterol milk products; Utilization of whey, caseinates etc., **Cleaning and disinfections in a dairy industry:** terms, definitions, cleaning and disinfection agents and processes; Cleaning in Place (CIP) and cleaning out of Place (COP).	

List of Experiments: **(Time: 36 hours)**

1. Quantitative estimation of moisture, %TS, ash, and fat in milk.
2. Analysis of titrable acidity of milk.
3. Analysis of specific gravity of milk and effect of water addition on it.
4. Performance of platform tests on given sample of milk.
5. Identification of preservatives and adulterants in milk.
6. Determination of bacteriological quality of milk by MBRT and Resazurin test.
7. Preparation of sterilized flavored milk.
8. Preparation of various milk products like Butter, Ghee, Ice Cream, Paneer,

Chhana, Milk Powder, Khoa etc.,
9. Visit to milk processing plant.

Course Learning Outcomes:

1. Understand the various properties and composition of milk.
2. Understand the technology of manufacturing of dried milk, cream, butter, ice cream, cheese and traditional dairy products will be understood various milk products.
3. Develop understanding of by-product utilization of dairy industry.
4. Apprehend the importance of cleaning, sanitation and CIP in dairy industry

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Vickie A. Vaclavik, Elizabeth W. Christian, Tad Campbell	*Essentials of Food Science (Food Science Text Series)*. 2nd edition	Springer International	2020	978-3030468132	481
Spreer E.	Milk and dairy product technology	TAYLOR & FRANCIS EXCL. SPL REPRINT	2018	978-1138385931	483
Smit G.	Dairy processing - improving quality	Woodhead Publishing	2003	9780849317583	536
Wong N. P.	Fundamentals Of Dairy Chemistry 3Ed	CBS Publishers	2001	978-8123906089	779
Rajagopal, Roy, S.K.	Milk & Milk Products Technology	BIO-GREEN BOOKS	2014	978-8178003252	765
Early R.	Technology of dairy product,	Springer-Verlag US	1997	978-0-7514-0344-2	446

Instrumental Analysis of Foods

L	T	P	Total Credits
4	0	0	4

Course Contents/Syllabus:

Instrumental Analysis of Foods	Teaching hours
Unit I: Analysis of Moisture, and principal food constituents in Foods	**18 h**
Methods of analysis, introduction and scope of various analytical methods for food samples such as food color, pH value and turbidity; Importance, methods and types of sampling; Uses and roles of various grinding instruments/ machines for preparation of samples for analysis; Expression of results; Methods of moisture analysis in food – drying methods; Near infrared (NIR) techniques, isothermic technique. Analysis of principal food constituents such as carbohydrates, proteins, fat, vitamins and minerals by various methods.	
Unit II: Food Component Separation Methods	**18 h**
Methods for separation, identification and quantification of various food components; Separation methods – filtration, centrifugation, sedimentation; **Electrophoresis:** gel electrophoresis, paper electrophoresis, high voltage electrophoresis, starch gel electrophoresis; Basic principles of spectroscopy: UV, visible and fluorescence spectroscopy.	
Unit III: Analysis of Texture and Rheology of foods	**18 h**
Refractometric techniques (refractive index) and instruments for various food components including flavour component and food additives; Methods for measuring textural properties of foods– Instron food tester, penetrometer, texture analyzer; **Methods for measuring rheological properties of foods** – visco-amylograph, extensograph, alveograph, farinograph and mixograph etc.	
Unit IV: Advanced Instruments in Food Sciecne	**18 h**
High performance liquid chromatography (HPLC)– types of column and their applications, high pressure pumps, various types of detectors for HPLC; Gas chromatograph (GC) and gas liquid chromatography (GLC); FTIR and Raman Spectroscopy in their applications in food.	

Course Learning Outcomes:

1. Understand the role of moisture in food.
2. Demonstrate moisture analysis in foods.
3. Acquire various techniques for food quality analysis.
4. Perceive practical proficiency in a food analysis laboratory and selection of a suitable method for food analysis.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Pomeranz Y. J.	Food Analysis: Theory and Practice	CBS Publishers & Distributors Pvt Ltd, India;	2004	978-8123904740	778
Srivastava	Instrumental Approach to chemical analysis	S Chand & Company	2010	978-8121916592	664

Winton A. L.	Techniques of food analysis	Agrobios India	2006	978-8177541076	998
Das H.	Food processing operations analysis,	Asian Books private ltd.	2005	978-8186299784	416

Statistical Quality Control for Food Industry

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Statistical Quality Control for Food Industry	Teaching hours
Unit I: Statistical terms and notations	**14 h**
Statistical terms and notations, frequency distribution, frequency curve, measures of central tendency and dispersion, Binomial and poission distribution; Introduction to sampling.	
Unit II: Statistical Methods	**13 h**
Statistical Methods: normal distribution, test of significance, null hypothesis, types of error, level of significance and degree of freedom, steps involved in testing of hypothesis, z-test, t-test for testing sample mean and difference between two means, paired t- test, chi-square test for testing goodness of fit and independence of attributes in 2×2 contingency table, yates correction, F-test, analysis of variance, correlation and regression analysis.	
Unit III: Statistical quality control	**14 h**
Statistical quality control: Introduction, advantages and limitations; Techniques of statistical quality control, control charts for variations, $\bar{x}$ and R chart, control chart for attribution, c chart, p chart, np chart; consumer risk, producer risk; Acceptance quality level (AQL); Lot tolerance percentage quality level (LTPD), process average fraction defective. Operative characteristic curve, simple and double sampling plans for prepackaged foods.	
Unit IV: Computer aided statistical tools designs	**13 h**
How to use excel; Computer aided statistical tools designs: SPSS, RSM, PCA, One-way ANOVA, two-way ANOVA, MANOVA	

Course Learning Outcomes:

1. Acquire basic concept and ideas of Statistical quality control and different Statistical methods.
2. Understand basics of control chart for variables and for attributes with its application, concept of Process Capability Analysis (PCA).
3. Solve the problems regarding measures of central tendency and measures of dispersion and problems related to chi square test, analysis of variance, regression analysis.
4. Understand concept of sampling, sampling distribution and its application.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Gupta S. P.	Statistical Methods.	Sultan Chand and Sons.	2019	978-9351610281	
Hubbard M. R.	Statistical quality control for food industry,	Springer Publishers.	2005	978-1461349440	343

Gupta S. C. & Kapoor V. K.	Fundamentals of Applied Statistics.	Sultan Chand and Sons.	2019	978-9351611127	343

Engineering Graphics & Drafting

L	T	P	Total Credits
3	0	0	3

Course Contents/Syllabus:

Engineering Graphics & Drafting	Teaching hours
Unit I: Drawing Techniques	**14 h**
Drawing Techniques: Various types of lines, principles of dimensioning, size and location of dimensions, symbols, conventions scales (plane and diagonal) and lettering as per IS Code SP-46 of practice for general engineering drawings. Practice of drawing various types of lines and dimensioning exercises. Drawing exercises pertaining to symbols, conventions. Exercise on lettering techniques: Free hand printing and numerals in 3,5,8 and 12 mm sizes vertical and inclined at 75°; instrumental lettering in single stroke.	
Unit II: Projection and Sectioning of Solids	**13 h**
Projection and Sectioning of Solids: Projection of solids such as Prisms, Pyramids, Cylinders, Cones, Spheres, Auxiliary View. Principles of sectioning, types of sectioning, section lines, cutting plane lines. Practice on projection of solids. Practice on sectioning of solids by auxiliary planes. Isometric Projection: Exercises on isometric views. Orthographic Projections: Orthographic views, Missing views. Exercises on identification of missing views. Practice on orthographic projections.	
Unit III: Intersection and Development of Surfaces	**14 h**
Intersection and Development of Surfaces: Intersection of cylinders, cones and Prisms, Axis of solids being vertical or horizontal. Development of surfaces of truncated cylinders, cones and prisms. **Exercises on intersection of solids** - cylinder and cylinder, cylinder and cone, prism and prism, prism and cone, sphere with cylinder. Exercises involving development of surfaces (Y-Piece, Hopper, Tray and truncated pieces).	
Unit IV: Introduction to fasteners	**13 h**
Fasteners: Introduction to temporary and permanent fasteners, rivetted and welded joints, types of screw threads, conventional symbols for internal and external threads. Exercises involving drawing of bolts, nuts, studs and locking devices. **Symbols and Conventions:** Symbols and conventions pertaining to relevant engineering disciplines. Practice in using Auto CAD or similar graphic package for preparing simple drawings.	

Course Learning Outcomes:

- Learning about basics of drawing techniques
- Acquiring knowledge of projection and sectioning of solids
- Demonstrate application of fasteners in engineering applications
- Perceive knowledge of symbols and conventions in the engineering drawing.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
PS Gill	Engineering Drawing	SK Kataria and Sons, Ludhiana.	2013	978-9350143155	690
N.K. Bhatt.	Engineering Drawing	Salwa books store	2011	9789380358833	736
RK Dhawan,	Textbook of Engineering Drawing	S Chand Publishing	2019	978-9352837373	776

Technology of Fats and Oils

L	T	P	Total Credits
3	0	0	3

Course Contents/Syllabus:

Technology of Fats and Oils	Teaching hours
Unit I: Introduction to History of Vegetable Oil Processing	**14 h**
Status of oils and fats in Indian economy, importance of fats and oils in foods; Sources, chemical composition and properties of fats and oils (plant and animal origin); Fats in diet, nutrition and disease, pretreatment and storage of oil seeds, reversion and rancidity of fats and oils, causes and prevention.	
Unit II: Processing Technology of Oilseeds	**13 h**
Extraction of oils: cold pressing and hot pressing, solvent extraction, rendering-removal and recovery of solvent form miscella, removal and recovery of solvent from extracted residue; Refining of oil; neutralization, degumming, bleaching, alkali refining, deodorization, winterization of oil, hardening of oil, generation and storage of hydrogen, production and regeneration of catalysts, filtration of hardened oil; Production of palm oil – rice bran oil, soybean oil, modifications of the properties of oils and fats including chemical and biotechnological processes, toxicity of frying oil, detection of adulteration.	
Unit III: Application of Animal Fats in Food Industry	**14 h**
Animal fats: industrial application; Lards, tallow: physical nature, production and storage, production of margarine, partial sterilization, emulsification, chilling, kneading and cooling; Incorporation of salt and coloring agent, confectionery plastic fat, application of plastic fat in bakery, confectionary (including cocoa butter replacers), shortening processing.	
Unit IV: Fat product development	**13 h**
Preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products low calorie spreads; By-products of fat/oil processing industries – oil seed protein isolates; quality standards of edible oils and fats; Antioxidants and rancidity of fats and oils	

Course Learning Outcomes:

1. Comprehend the importance and compositions of different fats.
2. Grasp the knowledge about the different methods of extraction.
3. Understand different methods of refining.
4. Understand various quality parameters in controlling the quality of fat.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Swern D.,	Bailey's Industrial Oil and Fat Products, 7 Volume Set	John Wiley &Sons.	2020	978-1119257882	4480

G. Hoffmann, Steve L. Taylor	The Chemistry & Technology of Edible Oils and Fats	Elsevier Science, Kent,	2004	9780123520555 Ebook:9781483218359	384

(SEC): Technology of Beverages

L	T	P	Total Credits
3	0	0	3

Course Contents/Syllabus:

Technology of Beverages	Teaching hours
Unit I: Classification of beverages and additives	**14 h**
Beverages, importance of beverages in our diet, treatment of water for food industry. Technology of alcoholic and non-alcoholic beverages- wine, cider, brandy, perry, toddy. Fruit juice beverages, methods of production, preservation and packaging, physiological aspects of fruit juice production and methods of fruit juice clarification, Additives for beverages: Natural and synthetic sweeteners and colours, acids, emulsifiers, preservatives, flavours and flavour enhancers.	
Unit II: Technology of soft drinks and carbonation technology	**13 h**
Role of soft drinks in Indian market, Technology of soft drinks, mineral water, ingredients, and additives used in production of soft drinks. Manufacturing of carbonated and non-carbonated beverages, technology of carbonation, and application of CO2 in juice preservation.	
Unit III: Citrus beverages and drinks	**14 h**
Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low-calorie sweeteners in beverages. Equipments and machineries for juice pressing, methods of bottling, enzymatic clarification and debittering of juices. Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.	
Unit IV: Coffee and plantation products	**13 h**
Production, processing and chemistry of tea manufacturing, tea products such as soluble tea, tea concentrate, de-caffeinated and flavoured tea. Production, processing, roasting and brewing of coffee, soluble coffee manufacture, standards and specifications of coffee products, de-caffeinated coffee, and coffee brew concentrate and chicory. Cocoa processing and cocoa beverages	

Course Learning Outcomes:

1. Apprehend the technology of carbonated soft drinks.
2. Understand about the processing of different types of tea and coffee.
3. Grasp the technology of production of alcoholic beverages.
4. Understand about the physical, chemical and biological changes occurring in the processing and storage of both alcoholic and non-alcoholic beverages.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Ashurst P. R.	Chemistry and technology of Soft drink and fruit juices	Blackwell Publishing Ltd.	2016	978-1444333817	424
Steen D. P. & Ashurst P. R.	Carbonated soft drinks – Formulation and manufacture	Wiley-Blackwell (an imprint of John Wiley & Sons L	2000	978-1405134354	376

Bamforth C. W.	Food, fermentation and microorganisms	Blackwell Science Publishing Ltd	2019	978-1405198721	264
Hui Y. H.	Handbook of Plant Based fermented technology & Beverages, T	CRC Press	2012	978-1439849040	821

Professional Ethics

L	T	P	Total Credits
2	0	0	2

Course content and syllabus

Professional Ethics	Teaching Hours
Unit I: Introduction to Professional Ethics	**9 hrs**
Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.	
Unit II: Basic Theories	**9 hrs**
Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.	
Unit III: Professional Practices in Engineering	**9 hrs**
Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession, Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.	
Unit IV: Workplace Rights and Responsibilities	**9 hrs**
Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation. Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing. Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights	

Course Learning Outcomes:

At the end of the course, students will be able to:

1. Understand basic purpose of profession, professional ethics and various moral and social issues.
2. Awareness of professional rights and responsibilities of an Engineer, safety and risk benefit analysis of an Engineer.
3. Acquire knowledge of various roles of Engineer In applying ethical principles at various professional levels.

4. Professional Ethical values and contemporary issues.
5. Excel in competitive and challenging environment to contribute to industrial growth.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
R. Subramanian	Professional Ethics	Oxford University Press	2nd edition/ 2017	9780199475070	472
Caroline Whitbeck	Ethics in Engineering Practice and Research	Cambridge University Press	2nd edition/ 2012	9780511976339	414

Entrepreneurship and New Venture Creation

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

Entrepreneurship and New Venture Creation	Teaching Hours
Unit I: Introduction to entrepreneurial ecosystem	**18 hrs**
Concept of entrepreneurship, entrepreneur's role, task and personality, theoretical perspective of entrepreneurship, entrepreneurial intention, entrepreneurial orientation, type of entrepreneurship, Understanding the entrepreneurial perspective in individuals, developing creativity and understanding innovation, Importance of entrepreneurship	
Unit II: Evaluating entrepreneurial options and understanding start up financial requirements	**18 hrs**
Understanding the idea and an opportunity. The opportunity creating, shaping, recognizing, and seizing. Screening venture opportunities, gathering information and analyzing. Evaluating venture opportunities and develop startup strategy. Feasibility analysis sand risk taking ability-An overview of startup finance and sources of finance. Understanding the business model and financial projections, how to forecast expenses and revenue. Gathering the resources developing entrepreneurial marketing and operational plan. Role of government institutions.	
Unit III: Launching and managing new venture -developing team and business plan	**18 hrs**
The importance of team, forming and building team. Examining sample business plans and writing business plan. Understanding the investor's perspective and presenting the business plan. Valuation of business plan and the elevator pitch. Entrepreneurial challenges as an individual and As an entrepreneur Skills of managing business risk and enhancing success.	
Unit IV: Emerging trends, technologies, and practices in startups - legal aspects of business	**18 hrs**
Legal form of new venture. Legal issues and other formalities related to venture.Technology-enabled trends that will help shape businesses and the economy, Technical intelligence in business- understanding technology threats and opportunities, Technology Business Incubators, emergence and growth of new technology–based companies	

Course Learning Outcomes:

At the end of this course, the students will be able to identify motivations of an entrepreneur for startingthe business, demonstrate entrepreneurial skill-set, identify sources of financing, Map the technological trends for new start-ups and Develop business plan

1. Develop the abilities needed to formulate a business plan for an original venture concept.
2. Apply knowledge and skills from live case studies of successful entrepreneurs and

business experience.

3. Enhance the ability to conduct sectoral study for a new venture creation/Start-up
4. Evaluate and develop potential business opportunities and Legal aspects of starting new venture

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
David H. Holt	Entrepreneurship: New Venture Creation	Prentice Hall	1991	978-0132826747	448
Leon Megginson ,Mary Jane Byrd , William L. Megginson	Small Business Management: An Entrepreneur's Guidebook	McGraw-Hill Education	2005	978-0071244640	544
Jeffry Timmons ,Stephen Spinelli	New Venture Creation: Entrepreneurship for the 21st Century	McGraw-Hill Education / Asia	2008	978-0071276320	704

Semester 6

B.Tech. Food Science Technology and Processing - 4 years (6th Semester)

B. Tech. Food Science Technology and Processing			Semester 6					
Course Code	Course Title	Course Type	Credits					Credit Units
			L	T	PS	FW	SW	
	Food Packaging	Core Course	3	0	1	0	0	4
	Food Safety and Standards	Core Course	4	0	0	0	0	4
	Food Plant Design and Process Modelling	Core course	3	0	1	0	0	4
	Meat, Fish and Poultry Processing	Core course	3	0	1	0	0	4
	Baking and Confectionary Technology	Specialization Elective Course	3	0	1	0	0	Anyone 4
	Food Flavors and Colors		4	0	0	0	0	
	Big Data for Life Sciences	Employability& Skill enhancement	3	0	1	0	0	4
			Total credits					24

Food Packaging

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Food Packaging	Teaching hours
Unit I: Introduction to food packaging	**14 h**
definitions, packaging terminology, functions of packaging, package environments; package selection: characteristics of food packaging material, shelf life of packaged food stuff. Fresh fruits and vegetables, meat, fish, poultry, dairy products, edible oils and spice products.	
Unit II: Different types of packaging material	**13 h**
Different types of packaging material: paper, metal, glass and plastic; Paper and paper based packaging materials: different types of pulp, paper making, types of paper, and properties of paper; Metal packaging materials: manufacture of tin plate, electrolytic chromium coated steel (ECCS), aluminum, container making process, corrosion and corrosiveness of foods and lacquers; Glass packaging materials: composition, properties, manufacture and closure; Plastic polymer as packaging materials: processing, classification and properties of polymers, additives in plastics.	
Unit III: Advancement in packaging technology	**14 h**
modified atmospheric packaging (MAP), Controlled atmosphere packaging, active packaging, Intelligent Packaging, Aseptic packaging of food, food packaging applications. Edible and bio based food packaging materials: edible films and coatings of different types, their barrier and mechanical properties, Printing processes, inks, adhesives and labeling of packaging materials; different types of printing material and processes, bar coding material, natural and synthetic adhesives, and types of label	
Unit IV: Food Packaging standards and recycling of packaging materials	**13 h**
Packaging standards and regulations: packaging performance and packaging equipments, Recycling of packaging materials: collection, separation and processing of paper packaging, food packaging from recovered paper, collection, separation and recycling,	

List of Experiments: **(Time: 36 hours)**

1. Introduction to different types of packaging materials used for food packaging.
2. Evaluation of water absorption capacity of CFB and paperboard
3. Evaluation of physical properties of packaging films
4. Evaluation of the uniformity and amount of wax determination.
5. Evaluation of chemical resistance of packaging material
6. Evaluation of water vapor transmission rate (WVTR) of different packaging material.
7. Evaluation of grease resistance of packaging material.
8. Pre-Packaging of Fruits and Vegetables.
9. Determination of tin coating weight and porosity.
10. Determination of continuity of lacquer coating.
11. Determination of tensile strength and heat seal strength of packaging material.
12. To conduct drop test.
13. Evaluation of the shelf life of packaged foods.
14. Determination of thermal shock resistance of glass containers.

Course Learning Outcomes:

1. Understand the objectives and functions of packaging.
2. Know different types and characteristics of packaging materials viz paper, glass, metal, and plastic.
3. Comprehend about different forms of packaging i.e. pouch, cans, bottles, tetra pack and their types.
4. Predict shelf life of different food materials.
5. Understand the packaging requirement of different types of foods.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Robertson G. L.,	Food Packaging: Principles and Practice. 2nd edition,	CRC Press, Boca Raton, Fla.,	2012	9781439862414,	703
Mattsson B., and Sonesson U.,	Environmentally Friendly Food Processing	CRC Press	2003	978-0849317644	337
Ahvenainen R.,	Novel food packaging techniques.	Woodhead Publishing Ltd.	2003	978-1855736757	

Food Safety and Standards

L	T	P	Total Credits
4	0	0	4

Course Contents/Syllabus:

Food Safety and Standards	Teaching hours
Unit I: Introduction to food safety and standards	**18 h**
Introduction, concept of food safety and standards, food safety strategies; Food hazards and contaminations – biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical factors; Food borne diseases causing agents. Water borne diseases, sources of contaminations and their effects.	
Unit II: Food safety inspection services	**18 h**
Food safety inspection services (FSIS) and their utilization; Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non-thermal processing, irradiation of foods; Environmental protection agency's (EPA) and their role in food safety system.	
Unit III: Fundamentals of quality management	**18 h**
Fundamentals of quality management principles, systems and requirements, Guidelines of performance improvements; GMP, GAP, GHP; ISO: Fundamental, requirement and guidelines.	
Unit IV: Bureau of Indian standards and Food and drug administration	**18 h**
BIS (Bureau of Indian standards); Food Safety and Standard act 2006, Food Authority of India and scientific panels, Codex Alimentarius Commission HACCP system of food protection: Principles and its applications, HACCP system for food safety; Food and drug administration (FDA).	

Course Learning Outcomes:

- Acquire basic understanding about the food safety and its significance in processing.
- Understand different adulterants and hazards and their safety measures.
- Understand different food laws and their importance.
- Grasp knowledge of international food laws and safety regulations.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
S P Singh, Julie Funk	Food Safety, Quality Assurance and Global Trade: Concerns and Strategies	International Book Distributing Co. Lucknow (Ibdchb)	2009	978-8181892683	384
Alli, I.	Food Quality Assurance: Principles and Practices	Taylor & Francis	2004	978-1138034532	168
Rekha, S. &	Handbook of Indian Food Quality and	Woodhead Publishing Ltd.,	1997	978-1855732995	560

Pushpa, R.	authenticity:	London			
Julie, Miller & Jones	Food safety	Association of official Analytical chemist USA.	1998	978-1138034532	168
Michael M. Cramera	Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices, Second Edition	CRC Press	2016	978-1138198791	306

Food Plant Design and Process Modelling

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Food Plant Design and Process Modelling	Teaching hours
Unit I: Principles of Process Design	**14 h**
Food science concepts such as: principles of conventional processes, minimal processing, non-thermal processing, and chemical kinetics. Principles of spreadsheet aided process design. Identification: Identification of design, operating and performance parameters in mechanical, thermal and mass transfer operations carried out in food processing; Mathematical Modeling: Developing mathematical relationship between the independent and dependent variables affecting the food processing operations by using physical and chemical principles governing the processes for, particulate size reduction, homogenization, centrifugation, packaging, mixing, conveying, extrusion, storage, heating, cooling, freezing, puffing, frying, distillation, extraction, concentration and drying; Corrosion of materials and prevention techniques, Linings for vessels and selection criteria.	
Unit II: Food Process Modeling, Empirical Model Development	**13 h**
Identification of independent and dependent parameters in food processing operations and product development; Factorial, fractional factorial and rotatable central composite experimental design; dependent parameters; Process Modelling and Optimization: Optimization techniques: direct search, linear programming, Dynamic programming.; Application of Response Surface Methodology in Process Optimization	
Unit III: Design of Equipment	**14 h**
High pressure vessels, Storage tanks for liquid and gases design procedures, Optimum tank proportions; Tall vertical vessels, Distillation columns, Evaporators Stress evaluation; Heat exchangers Flow arrangement and design procedure; Cost Analysis: Comparison of alternatives Depreciation Fixed capital, working capital, Break even analysis Payout period, Rate of return, Maintenance of equipments Pipe lines for process equipments Mechanical design Optimum diameter of pipe line for gases, liquids, steam; Piping diagram Codes and standards	
Unit IV: Plant Layout	**13 h**
: Layout of different types of food industries and process equipments : wheat and paddy milling, bread and biscuit manufacturing, fruits and vegetables processing, and dairy industries; shell and tube heat exchanger, evaporator, distillation column, dryer, pressure vessel, and storage tank, agitator, fermenter, pasteurizer, cold store, freezer, centrifuge, homogenizer, filtering devices, baking oven, canning equipment; Considerations for location of food processing plants, flow process charts, machine flow diagrams, selection of processing and handling machines; Plant utilities-electricity, water, steam, air, raw material requirements; application of systems design and principles, plant specifications and cost estimates, plant profile, process plant sanitation and hygiene.	

List of Experiments: **(Time: 36 hours)**

1. Preparation of project report;
2. Preparation of feasibility report;
3. Layout of Food storage wares and godowns
4. Layout and design of cold storage
5. Layout of preprocessing house

6. Layout of Milk and Milk product plants
7. Bakery and related product plant
8. Fruits processing plants; Vegetable processing plants
9. Layout of multi-product and composite food Plants
10. Waste treatment and management of food plant
11. Visit to Fruit and Vegetables processing plant.

Course Learning Outcomes:

1. Understand the principles of food process design and modelling.
2. Grasp the basics behind the designing of equipments.
3. Understand the plant layout design for different types of food industries.
4. Understand the plant layout design for different types of process equipments.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Das H.	Food Processing Operations Analysis	Asian Books Publication New Delhi.	2008	978-8186299784	416
George D. Saravacos, Zacharias B. Maroulis	Food Process Design	CRC Press Inc; 1st edition CBS PUBLISHERS & DISTRIBUTORS PVT. LTD	2003	978-0824743116	536
Luyben W. L.	Process Modelling, Simulation and Control for Chemical Engineers,	McGraw Hill Education	2014	978-9332901681	725
Tijskens L. M. M., Hertog A. T. M & Nicolai, B. M.	Food Process Modeling,	CRC Press ; Woodhead Pub., Boca Raton, Fla., Cambridge, England,	2001	9781855736375	504

Meat, Fish and Poultry Processing

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Meat, Fish and Poultry Processing	Teaching hours
Unit I:	**14 h**
Status and scope of meat and poultry industry in India; Muscle- structure, chemical composition and physico-chemical properties of meat muscle, nutritive value, conversion of muscle into meat; Slaughtering of animals and poultry, post-mortem inspection and grading of meat; Factors affecting post- mortem changes, properties and shelf life of meat; Meat tenderization - natural and artificial methods.	
Unit II:	**13 h**
Processing and preservation of meat - mechanical deboning, aging or chilling, freezing, pickling, curing, cooking and smoking of meat; Thermal processing-canning of meat, retort pouch, dehydration and irradiation; Meat Products - uncooked comminuted and restructured meat products, sausages, meat emulsions, dried meats, intermediate moisture meats and meat extracts, ready to eat (RTE) meat products. Meat plant sanitation and waste disposal.	
Unit III:	**14 h**
Poultry products: types, chemical and nutritive value of poultry meat; Poultry handling and dressing: inspection of birds, poultry slaughter and dressing, factors affecting quality of poultry; Egg: structure, composition and nutritive value of eggs, changes in egg due to aging; Quality evaluation of eggs, candling, albumen index, Haugh unit, yolk index; Egg preservation: grading of eggs, whole egg preservation, pasteurization, dehydration, freezing; Egg products: egg powder, value added egg products (Meringues and Foams etc.), packaging of egg and egg products.	
Unit IV:	**13 h**
Fish products - production of fish meal, fish protein concentrate, fish liver oil, fish paste and fish sauce and other important by products; Quality control of processed fish; Fish processing; By-product utilization: By-products and wastes from meat and poultry industry; HACCP in meat industry.	

List of Experiments: **(Time: 36 hours)**

1. Slaughtering and dressing of poultry bird (Video Tutorial)
2. Slaughtering and dressing of goat (Video Tutorial)
3. Determination of water holding capacity of meat
4. Determination of extract release volume
5. Determination of meat pH
6. Estimation of total meat pigments
7. Determination of metmyoglobin content of meat
8. Preparation of meat products
9. Preparation of blood meal
10. Tenderization of meat
11. Composition and structure of egg
12. Determination of egg quality by Haugh unit
13. Preservation of shell egg
14. Study of anatomy and dressing of fish
15. Preparation of fish protein concentrate (FPC)

Course Learning Outcomes:

- Understand the muscle composition, structure, and properties of muscle meat.
- Understand the process of manufacturing of various value-added meat, poultry, and products.
- Understand the process of manufacturing of various value-added fish products.
- Learn about the various food standards in relation to meat, fish, poultry, and egg.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Mead G.	Poultry Meat Processing and Quality	Woodhead Publishers.	2004	978-1855737273	400
Panda P. C.	Textbook of Egg and Poultry Technology Prafulla Chandra Panda	Vikas Publishing House	1998	9780706989519	216
Sahoo J. & Chatli M. K.	Textbook On Meat, Poultry And Fish Technology	Daya Publishing House.	2022	9789351243441	836
Kerry J. P.	Advances in Meat, Poultry and Seafood Packaging	Woodhead Publishing Limited.	2012	978-1845697518	720
Vikas Nanda	Meat, Egg and Poultry Science and Technology	Dreamtech Press	2020	978-9389795738	298

Baking and Confectionary Technology

L	T	P	Total Credits
3	0	1	4

Course Contents/Syllabus:

Baking and Confectionary Technology	Teaching Hrs
Unit I: Introduction to Bakery and Confectionary	**14 h**
Introduction to bakery and confectionery industries in India; Raw materials for bakery and confectionery products- essential and optional ingredients; Functionality of bakery ingredients; FSSAI specification of raw materials; Bakery equipments: divider, rounder, proofer, moulder; equipments used in baking, different types of ovens, slicer.	
Unit II: Bread Technology	**13 h**
Different types of bread and preparation of bread using different methods, quality evaluation of bread, bread faults and remedies, staling of bread, safety standards for bread industry; Preparation of other bakery products: buns, muffins and pizza.	
Unit III: Biscuits Technology	**14 h**
Biscuits: Types, methods of preparation and quality evaluation. **Cakes:** Types, methods of preparation and quality evaluation of cakes, cake faults and remedies, safety standards for biscuit and cake industry	
Unit IV: Confectionary	**13 h**
Confectionery- Raw materials, types, process, and machinery; **Types of candies:** boiled sweets, hard candy, brittle; **chocolates:** manufacturing process, quality consideration and parameters; Manufacturing process of toffees, caramels, lozenges, chewing gum, bars; Sugar free confectionary	

List of Experiments: **(Time: 36 hours)**

1. Making of bread and evaluation for color, texture and sensory characteristics.
2. Making of biscuits and cookies for color, texture and sensory characteristics.
3. Making of cakes and puff pastries for color, texture and sensory characteristics.
4. Making of Pizza base for color and sensory characteristics.
5. Making of chocolates and sensory evaluation
6. Making of confectionary products (toffees, bars etc.,)

Course Learning Outcomes:

- Understand various raw materials used for preparation of various bakery and confectionary products.
- Have knowledge on basic operation and working of various equipments involved in bakery and confectionary technology.
- Understand the various processes used for the manufacturing of bakery products like bread, biscuits, cakes, muffins and their quality determination.
- Acquire knowledge of the various processes used for the manufacturing of confectionary products like chocolate, candies, toffees, gums and their quality determination.
- Acquire knowledge on food safety rules and regulations for bakery and confectionary products.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Khatkar B. S.	Baking Science and Technology	Arihant Publication	2011	9380872305	
Manley D.	Technology of Biscuits, Crackers & Cookies. 2nd Edition,.	CRC Press	2000	978-1845697709	632
Mohos F.	Confectionery & chocolate engineering, principles & applications,	Wiley Blackwell Publishing Ltd.	2010	978-1118939772	792
Edwards W.P.	The Science of bakery products,	RSC Publications.	2007	978-0854044863	245

Food Flavours and Colours

L	T	P	Total Credits
4	0	0	4

Course Contents/Syllabus:

Food Flavours and Colours	Teaching hours
Unit I: Introduction to food flavors	**18 h**
Definition, classification and types, volatile and non-volatile flavoring compounds and their sensory characteristics; Natural food flavoring: Fruit, vegetables, spices, beverage, meat, fat, cooked flavors, uses in foods and importance of natural flavors.	
Unit II: Flavors in processed foods	**18 h**
Development of flavors in processed foods, role of microbes, thermal reactions, off flavors in foods; Synthetic flavorings: Flavoring materials, terminology, flavor extraction and production methods, compounding of flavors, flavor encapsulation, functional uses and applications in food products, flavor enhancers, functions and stability in foods.	
Unit III: Food colorants	**18 h**
Natural pigments from plant and microbial sources, color stability, need of color addition, color loss during thermal processing, applications of natural colorants, types of colors, uses of synthetic colorants.	
Unit IV: Certified colors	**18 h**
Colorants subject to certification, color effects in certified foods, certified F, D and C colorants, Primary certified food colors, blending of colors, lakes and dyes, properties and uses of certified dyes and their regulatory aspects; Microbial colors: Methods of production, advantages and disadvantages, maximum permissible limits of food colors, standards for use in processed foods.	

Course Learning Outcomes:

1. Know about food flavors, types and their characteristics.
2. Learn methods, production, extraction of food flavors and their uses.
3. Gain knowledge of natural pigments sources and their applications in foods.
4. Understand regulatory, legal aspects of use of colors in foods and their standards.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Fisher C. & Scott T. R.	Food flavours- Biology and Chemistry,	The Royal Society of Chemistry.	1997	978-0854045389	176
Branen A. L., Davidson P. M. & Salminen S.	Food Additives 2nd edition,	Marcel Dekker Inc.	1980	978-1498783026	952

Big Data for Life Sciences

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

Big Data for Life Sciences	Teaching Hours
Unit I: Introduction of Big Data	**13 hrs**
Introduction – distributed file system – Big Data Skills, Exploring, managing and cleaning Big Data, Importance of Big Data, Four Vs, Drivers for Big data, Big data privacy and security issues, Significance of Big data in personalized or precision medicine , Revolutionizing big data approaches for Precision medicine, New hope for cancer treatment with big data analytics and personalized medicine, Opportunities for Clinical big data, Big Data with Python, Big Data with R, Big Data with Artificial Intelligence.	
Unit II: Hadoop Framework	**14 hrs**
Introduction to Hadoop, HDFS, HDFS Components, Linux commands, Hadoop commands, Hadoop architecture, NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Method of Map-Reduce life cycle, Custom Partitioner & Combiner in Map-Reduce ,Job, Task trackers. Hadoop Eco System, Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce.	
Unit III: Hive and HBASE	**13 hrs**
Hive Architecture , HBASE vs RDBMS, HBASE vs Hadoop, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBASE concepts, CRUDE with HBASE, Hbasing with Java,HQL, NOSQL, HShell ,Hive HBASE Integration.	
Unit IV: Computing for Big Data Analysis	**14 hrs**
Data classification, Tabulation, Frequency and Graphic representation, Measures of central tendency, Measures of central dispersion, Normal Probability Distribution, Hypothesis Testing, Correlation, Linear Regression Analysis, Examples using data from life sciences.	

List of Experiments:

1. Installation of java.
2. Installation of Hadoop framework.
3. Configuring Hadoop.
4. Running Job in Hadoop.
5. Linux commands.
6. Hadoop commands.
7. Installation of HBASE framework.
8. Execution of DDL command of HBASE
9. Execution of DML command of HBASE.
10. Word-Count Example with Map-Reduce.
11. Analyzing Temperature dataset using Map-Reduce.
12. Creating the tables in the hive and storing the huge amount of data in the tables created in the hive.
13. Loading the data in the tables by running commands in the hive.
14. Putting the data into the Hadoop server.
15. Single table insertion and multiple table insertion.
16. Implementation of HBASE with Java Code.
17. Find the number of occurrences of the word using Map Reduce in a text file.
18. We have to import data present in the file into an HBASE table by creating it through Java API.

Course Learning Outcomes:

Students will be able to

1. Apply the principles of Big Data with reference of Life Science.
2. Evaluate the principles of HDFS and Map-Reduce paradigm in Big Data.
3. Identify the techniques of Big Data using HBASE and Hive.
4. Demonstrate the concept of statistical analysis with the help of Big Data Analytics.
5. Illustrate the various pipelines in Big Data Analytics

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Boris lublinsky, Kevin t. Smith, AlexeyYakubovich	Professional Hadoop Solutions	Wiley	2015	9788126551071	504
Chris Eaton,Dirk deroos	Understanding Big data	McGraw Hill	2012	--	
Sima Acharya, Subhashini Chhellappan	BIG Data and Analytics	Willey	2019	978-8126579518	
Tom White	HADOOP: The definitive Guide	O Reilly	2012	978-9352130672	

Semester 7

B.Tech. Food Science Technology and Processing - 4 years (7th Semester)

B. Tech. Food Science Technology and Processing				Semester 7					
S. No	Course Code	Course Title	Course Type	Credits			Credit Units		
				L	T	PS	FW	SW	
1		Economics for Engineers	HSSMC	2	0	0	0	0	2
2		Sociology for Engineers	HSSMC	1	0	0	0	0	1
3		Law for Engineers	HSSMC	2	0	0	0	0	2
4		Aspects of Indian History for Engineers	HSSMC	1	0	0	0	0	1
5		**Any three courses:**							
		Food Additives	SEC	4	0	0	0	0	12
		Spices and Herbs	SEC	4	0	0	0	0	
		Fats And Oil Technology	SEC	3	0	1	0	0	
		Technology of Frozen Foods	SEC	4	0	0	0	0	
		Bioprocess Engineering	SEC	4	0	0	0	0	
		Waste Management and Effluent Treatment	SEC	3	0	1	0	0	
6.		*Students will choose any one course**							3
		1) Baking and Confectionary Technology	OE	3	0	0	0	0	
		2) Nanotechnology in Food Processing	OE	3	0	0	0	0	
7		Project Work	NTCC	0	0	3	0	0	3
				Total credits			**24**		

HSSMS: Humanities, social sciences, and management courses; SEC: Specialization elective course; OE: open elective course; NTCC: non-teaching credit course

Economics for Engineers

L	T	P	Total Credits
2	0	0	2

Course content and syllabus

	Teaching hours
Unit I Overview	**9 hrs**
Definition of economics, nature of economic problem, relation between science, engineering, technology and economics. Concepts and measurement of utility, law of diminishing marginal utility-its practical applications and importance. Law of demand, elasticity of demand (price, income and cross)-Measurement, practical importance and applications.	
Unit II Supply and Elasticity of Supply	**9 hrs**
Law of supply, elasticity of supply and its practical applications, market equilibrium Production, factors of production, production functions (one variable, two variable, all variable and Cobb-Douglas)	
Unit III: Concepts of Revenue and cost	**9 hrs**
Costs, various concepts of cost and revenue in short and long run. Cost and revenue curves Meaning of market, types-Perfect, Monopoly, Oligopoly, Monopolistic (Main features)	
Unit IV: Concepts of National Income	**9 hrs**
Concepts of GDP, GNP, NI and Disposable income. Aggregate demand and supply (Both open and closed economies) Basic concepts of inflation, deflation, stagflation, business cycles and BOP	

Course Learning Outcomes:

1. Students should be able to define the various economic concepts of Utility, demand, production function, cost and revenue curves and business cycles.
2. Compare different market structures.
3. Students should be able to explain practical importance and applications of various economic tools.
4. Students should be able to interpret basic macroeconomic concepts in existing economic structure of the country.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
H.L. Ahuja	Microeconomics	S. Chand & Co. Ltd., New Delhi	2019	978-9352837311	872
Samuelson & Nordhaus	Economics,	Tata Mc-Graw Hill Publishing Co. Ltd., New	2019	978-9389538038	994

		Delhi.			

Sociology for Engineers

L	T	P	Total Credits
1	0	0	1

Course contents and syllabus	Teaching Hours
Unit I Overview	**9 hrs**
Sociological perspective; Sociology as a science; Sociology and other social Sciences, Society, community, Institution, Association, Social Structure, Social Function, Status and Role and its Elements.	
Unit II Sociological Concepts	**9 hrs**
Introduction to sociological concepts- social institutions, Culture social stratification(caste, class, gender, power), Social Change.	

Course Learning Outcomes:

- Understanding of professional and ethical Responsibility
- To discuss the dynamics and nature of Indian Society.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Giddens, A.	Sociology,	Polity	6th/2009	978-1509539222	1152
Haralambos M, RM Heald, M Holborn	SOCIOLOGY:THEMES AND PERSPECTIVES,	Collins	2000	978-0007583195	

Law for Engineers

L	T	P	Total Credits
2	0	0	2

Course contents and syllabus	Teaching Hours
Unit I: Introduction to Law and Law Making	**9 hrs**
Law: its meaning, sources and concepts; Constitutional Law with emphasis on Fundamental Rights, Directive Principles of State Policy and Fundamental Duties; Law making in India. **General Principles of Contract under Indian Contract Act, 1872:** Sec. 1 to 75 of Indian Contract Act and including Government as contracting party, Kinds of government contracts and dispute settlement, Standard form contracts; Promissory Estoppel and Legitimate Expectations.	
Unit II: Adjudicatory System in India	**9 hrs**
Adjudicatory System in India as under the Constitution and statutes; Tribunals and Commissions like Competition Tribunal and Consumer Protection Commissions; Alternative Dispute Resolution: Nature, Scope and Types; Arbitration and Conciliation Act, 1996; Legal Services Authority Act, 1986.	
Unit III: Law Relating to Intellectual Property	**9 hrs**
Concept of Property, Types of Property; Introduction to IPR; Types of IPR: Copyrights, Patents, Trademarks, Designs, Trade Secrets, Plant Varieties and Geographical Indications; Infringement of IPRs and Remedies available under the Indian Law.	
Unit IV: Privacy in Governance and Transparency	**9 hrs**
Confidentiality in Government Business/Administration: Official Secrets Act, 1923; Right to Information Act, 2005 covering, Evolution and concept; Practice and procedures; Privileged Communications under the Indian Evidence Act, 1872; Offences under the Information Technology Act, 2000 with special reference to Protected Systems; Labour Disputes and the Settlement – Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Payment of Wages Act, 1936.	

Course Learning Outcomes:

On successful completion of course, students will

- Gain exposure to the students about the elementary knowledge of law that would be of utility in their profession.
- Enable the students to appreciate the importance of law and its impact on business and society.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
D.D. Basu	Shorter Constitution of India	Prentice Hall of India	1996	978-8131265284	
M.P. Jain	Indian Constitutional Law	Wadhwa & Co	2005	978-9386515049	2320

Aspects of Indian History for Engineers

L	T	P	Total Credits
1	0	0	1

Course contents and syllabus	Teaching Hours
Unit I Ancient India: The beginning (2600- 600 BCE)	**4.5 hrs**
Salient features of Harappan Culture Town planning, Drainage system, Great Bath, Buildings, Seals, Social and economic condition, Reasons of decline Vedic Period Vedic literature, Social, Political and Economic conditions Rise of Buddhism and Jainism	
Unit II From states to empires	**4.5 hrs**
Early kingdoms & republics : Sixteen Mahajanpadas & ten Republics The Mauryan Empire: Origin & growth, Administration, Achievements of Chandragupta, Ashokan Dhamma policy	
Unit III: The Golden Period	**4.5 hrs**
Achievements of Kanishka, Samudragupta and Chandragupta II, The Gupta administration & its decline. Main features of the Golden Era.	
Unit IV: Scientific Achievements in Ancient India	**4.5 hrs**
Astronomy in ancient India Mathematics in ancient India Civil engineering & architecture in ancient India Science, Medicine, Technology in ancient India Agriculture Development and ecological balance in ancient	

Course Learning Outcomes:

1. Identify major dynasties.
2. Examine social, economic and cultural conditions.
3. Analyze the scientific achievements.
4. Recognize the ancient heritage.
5. Examine the past and present scenario.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Upinder Kaur	A History of Ancient and Early Medieval India: From the Stone Age to the 12th Century	Pearson	2016	978-8131774748	728
Romila Thapar	Penguin History of Early India	Penguin	2003	978-0143029892	555

Food Additives

L	T	P	SW/FW	Total Credit Units
4	0	0	0	4

Course content and syllabus

Food Additives	Teaching Hrs
Unit I: Food Additives: An Introduction	**16h**
Food Additives: definitions, classification and applications, food preservatives- classifications, antimicrobial agents, types and their action, safety concerns, regulatory issues in India, international legal issues; Antioxidants (synthetic and natural, mechanism of oxidation inhibition); Chelating agents: types, uses and mode of action; Coloring agents: color retention agents, applications and natural colorants, sources of natural color, misbranded colors, color extraction techniques, color stabilization	
Unit II: Flavoring Agents	**12 h**
Flavoring Agents: flavors (natural and synthetic flavors), flavor enhancers, flavor stabilization, flavor encapsulation; Flour improvers: leavening agents, humectants and sequesterant, hydrocolloids, acidulants, pH control agents buffering salts, anticaking agents	
Unit III: Sweeteners	**14 h**
Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products; Emulsifiers: types, selection of emulsifiers, emulsion stability, functions and mechanism of action	
Unit IV: Nutrient supplements & thickeners	**14 h**
Nutrient supplements & thickeners: polysaccharides, bulking agents, antifoaming agents, synergists, antagonists; additives food uses and functions in formulations, permitted dosages, indirect food additives; harmful effects/side effects associated with various additives (various diseases)	

Course Learning Outcomes:

- To get an insight into additives that are relevant to processed food industry for shelf-life extension, processing aids and sensory appeal.
- To explain about role of food additives in food quality control.
- To explain the techniques of best use of food additives.
- To describe the role of food additives in health maintenance and cure of diseases

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Branen A. L., Davidson P. M., and Salminen S	Food Additives. 2nd edition	CBS PUBLISHERS & DISTRIBUTORS PVT. LTD.	2000	978-1498783026	952

Gerorge A. B	Encyclopaedia of Food and Color Additives. Vol III	CRC Press	1996	9780429157677	3153
Gerorge A. B	Fenaroli's Handbook of Flavor Ingredients: Volume 2 (Routledge Revivals)	CRC Press	2004	978-0367262952	990
Morton I. D., and Macleod A. J	Food Flavours. Part A, B & C	Elsevier	1990	9780444425997	379
Stephen A. M.	Food Polysaccharides and Their Applications	Marcel Dekker	2006	9780824759223	733

Spices and Herbs

L	T	P	SW/FW	Total Credit Units
4	0	0	0	4

Course content and syllabus

Spices and Herbs	Teaching Hrs
Unit I: Importance of spices in food industry	**18 h**
Introduction: Importance and role of spices in food processing, classification and properties of spices, scope of spice processing in India **Spices and culinary herbs:** Types, spice qualities and specifications, uses and physiological effects, components, antimicrobial and antioxidant properties of spices and herbs, important spices and medicinal herbs added in food products.	
Unit II: Spice processing	**18 h**
Spice and herb processing machineries; Advancements in spice processing technology; **Spice processing:** Processing and manufacturing of major Indian spices and herbs: Pepper, cinnamon, cardamom, nutmeg, saffron, turmeric and ginger. **Processing of Minor spices**- cloves, leafy spices, bay oregano, seed spices; Common herbs- brahmi, tulsi, mint, thyme, curry leaves, lemon grass etc.	
Unit III: Medicinal values of herbs	**18 h**
Medicinal values of herbs; Condiments and spice products, spice blends and extractives, essential and encapsulated oils, salad dressings and seasonings, oleoresins, uses in processed foods	
Unit IV: Packaging of spices and herbs	**18 h**
Packaging of spices and herbs: Packaging of spices, handling; packaging machineries, uses and limitations. Advancements in packaging technology for spices, and herbs.	

Course Learning Outcomes:

- To provide basic understanding about major and minor spices regarding production, classification, processing.
- To explain the concepts of spice essential oils and spice oleoresins with respect to method of extraction, isolation, and encapsulation.
- To describe the spice quality evaluation.
- To impart knowledge on effect of processing on spice quality.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Farrell K. T.	Spices, condiments and seasonings	The AVI Publications	1985	9780442004644	414
Purseglove J. W., Brown E. G., Green C. L. &	Spices	Longman Publications	1981	726537253	439

Robbins S. R. J.					
Hirasa K. & Takemasa M.	Spice Science and Technology	CRC Press	1998	9780367800451	232
Pruthi J. S.	Quality assurance in spices and spice products (Modern methods of analysis)	Allied Publishers Limited	1999	8123722435.	322

Fats And Oil Technology

L	T	P	SW/FW	Total Credit Units
3	0	1	0	4

Course content and syllabus

Fats And Oil Technology	Teaching Hrs
Unit I: Introduction to Fats & Oils	**13 hrs**
Introduction to Fats & Oils, Common chemical reactions of Fats & Oil, Nutritional properties of edible fats and oil, Non glyceride components of oils & fats, Status of oils and fats and Indian Economy, General chemistry, Analytical methods for characterization.	
Unit II: Physical and chemical properties of fats & oil	**14 h**
Physical and chemical properties of fats & oil, Antioxidants, Rancidity and Reversion, oil and fats in diet, nutrition and disease. Hydrogenation, Fractionation and winterization of edible fats, Extraction and clarification of vegetable oil.	
Unit III: Application of Plastic fats in food Industry	**13 h**
Confectionery plastic fats, preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products, low calorie spreads, Animal fat, oil derivatives, Use of edible oils and fats in foods	
Unit IV: Quality standards of edible oils and fats.	**14 h**
Quality standards of edible oils and fats. Detection of adulteration. Technology of oilseed protein isolate, Packaging of edible oils, by product utilization from oil industries.	

Lab/ Practical details:

Objective*:* The laboratory exercises in this section have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipment.

List of Experiments -with basic instructions

1. Experimental expeller processing of oilseeds.
2. Solvent extraction process.
3. Determination of Iodine value, saponification value, R.M. value, Kirschner, Polenski value, melting point and peroxide value of fats and oils sample.
4. Adulterants in fats and oils.
5. Imitated dairy products, margarine etc.
6. Production of protein concentrates and isolates.
7. Determination of anti-oxidant-used in oil.

Course Learning Outcomes:

- Understand the production, classification and processing of pulses and oilseeds.
- Know the various anti nutritional factors in pulses and methods of their removal.
- Apprehend the technology of extraction and refining of oils.
- Understand the problems associated with refining and by-product utilization

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Chakraborth A.	Post-Harvest Technology of Cereals, Pulses and Oil seeds	OXFORD & IBH PUBLISHING	2008	9788120409699	368
Smartt J. & Nwokolo E.	Food and Feed from legumes and oilseed	Springer New York, NY	1996	978-1-4613-8050-4	419
Swern D.,	Bailey's Industrial Oil and Fat Products, 7 Volume Set	John Wiley &Sons.	2020	978-1119257882	4480
G. Hoffmann, Steve L. Taylor	The Chemistry & Technology of Edible Oils and Fats	Elsevier Science, Kent,	2004	9780123520555 Ebook:9781483218359	384

Technology of Frozen Foods

L	T	P	SW/FW	Total Credit Units
4	0	0	0	4

Course content and syllabus

Technology of Frozen Foods	Teaching Hrs
Unit I: Physical aspect of freezing process	**18 hrs**
Current status of frozen food industry in India, physical aspect of freezing process: heat transfer during freezing, freezing time, convective (air freezing, brine freezing, cryogenic freezing) and conductive processes (contact and scraped freezers) of freezing, changes during freezing, glass transitions, thermophysical properties of frozen foods, freezing load, Individual Quick Freezing (IQF); freezing time calculations	
Unit II: Innovation in freezing process	**18 hrs**
Innovation in freezing process, freeze concentration, dehydrofreezing, freeze drying, cryogenic freezing, freeze damage, changes during frozen storage, thawing techniques and microbial quality of thawed foods; Freezing methods and equipment, cold store design, transportation of frozen foods, retail display equipments, household refrigerators and freezers, monitoring and control of the cold chain	
Unit III: Quality and safety of frozen foods	**18 hrs**
Quality and safety of frozen foods: quality and safety of frozen meat, fish, poultry and their products, quality and safety of frozen vegetables, fruits, dairy products, ready meads, bakery products, eggs and eggs products; sensory analysis and shelf-life evaluation of frozen foods	
Unit IV: Packaging of frozen foods	**18 hrs**
Packaging of frozen foods: Introduction to frozen food packaging, different materials used for packaging, packaging machinery; Recent trends in frozen food packaging: active packaging, intelligent packaging, vacuum packaging and application of edible films on frozen foods	

Course Learning Outcomes:

- Understand about the concept of freezing.
- Acquire knowledge about equipment and process used for food freezing.
- Understand maintenance of quality of frozen food.
- Choose and use any packaging material for frozen food.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Hui Y. H., Legarretta I. G., Lim M. H., Murrell K.D. & Nip W.	Handbook of Frozen Foods	CRC Press	2004	9780824747121	1293
Sun D.	Handbook of Frozen Food Processing	CRC Press	2011	9781138627147	936

	and Packaging, Second Edition,				
Evans J. A.	Frozen Food Science and Technology	Wiley-Blackwell.	2011	9781444302325	355

Bioprocess Engineering

L	T	P	SW/FW	Total Credit Units
4	0	0	0	4

Course content and syllabus

Bioprocess Engineering	Teaching Hrs
Unit I: Introduction to microorganisms	**18 hrs**
Kinetics of microbial growth and death: definition, fermentation kinetics rate of cell synthesis, product formation and effect of environment, types of kinetics, batch and continuous type, control measures, instrumentation, and fermentation economics.	
Unit II: Enzymes kinetics	**18 hrs**
Simple enzyme kinetics: simple kinetics model for enzyme substrate interaction. Derive the equation of Michelin Menton for reaction rate, product formation and calculation of Km and V max values; **complex enzyme kinetics:** oxidation–reduction form of enzymes, observed apparent rate constant, factors affecting the inhibition, competitive, non-competitive inhibition, substrate interaction; **kinetics pattern of various fermentations:** classification, simple, simultaneous, consecutive, stepwise, complex reactions, and their examples	
Unit III: Heat treatments	**18 hrs**
Air sterilization, aeration and agitation: definition, thermal death time, media heat sterilization, advantages of continuous sterilization. aeration and agitation: oxygen requirement of industrial fermentations, determination of K La Value, factors affecting K La value. Fermenter: design, operation and their problems during Scale up, management of cellular process	
Unit IV: Downstream processing and product recovery	**18 hrs**
Downstream processing and product recovery: separation techniques like adsorption, chromatography, precipitation, ultra-filtration etc., purification techniques: spray drying, fluidized bed drying etc, Product formation for value added products using bioconversions techniques, production of antibiotics, economic process, utilization of by-products through bioconversion, present mode of utilization and their nutritional value.	

Course Learning Outcomes:

- Understand the operation and maintenance of fermenter.
- Understand production of various microbial products by fermentation.
- Comprehend the bioconversion and their recovery.
- Understand the role of enzymes in food industry and their production.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Shuichi Alba, Arthur E., Humphrey and Nancy F., Millis	Biochemical Engineering	Academic Press Inc	1973	978-0120450527	434

Baily J.E., and Ollis D.F.	Biochemical Engineering Fundamentals	McGraw Hill Education	2017	978-0070701236	753
Shuler M. L., and Kargi F.	Bioprocess Engineering	Pearson	2014	9781292025995	542
Lee J. M.	Fundamentals of biochemical engineering	Prentice Hall	1992	9780130853172	321
Ghose T.K.	Bioprocess Computations in Biotechnology	Ellis Harwood Ltd.	1990	9780130846747	330

Waste Management and Effluent Treatment

L	T	P	SW/FW	Total Credit Units
4	0	0	0	4

Course content and syllabus

Waste Management and Effluent Treatment	Teaching Hrs
Unit I: Waste management	**18 hrs**
Waste generation in food processing industries; concept, scope, health and environmental concern in waste management and effluent treatment; Physicochemical quality of wastewater from different food processing industries- temperature, pH, dissolved oxygen, biological oxygen demand, chemical oxygen demand; Grease content, metal content, forms of phosphorus and sulphur in waste waters and other ingredients like insecticide, herbicides and fungicides residues	
Unit II: Unit operations	**18 hrs**
Physicochemical unit operations- screening, grit chamber, equalization, sedimentation, floatation, coagulation, flocculation, filtration, disinfection; Adsorption and ion exchange; Aeration and gas transfer; Membrane separation processes	
Unit III: Microbiological concept	**18 hrs**
Microbiological concepts: microbial characteristics waste- composition and classification, enumeration and identification of the microorganism in waste, pathogenic organisms, use of indicator organism; Biological treatment/Secondary treatment: aerobic and anaerobic biological treatment processes, combined aerobic and anaerobic treatment processes; Suspended growth and attached growth biological treatment; Oxidation ditches; Activated sludge process; Biological oxidation- trickling filters; Bio- towers; Rotating biological contractors, aerated lagoons; Anaerobic sludge blanket processes.	
Unit IV: Tertiary treatments	**18 hrs**
Tertiary treatments: advanced wastewater treatment process- sand, coal and activated carbon filters, phosphorus, sulphur, nitrogen and heavy metals removal; Disinfection processes- theory, characteristics of disinfectants, mechanism and factors influencing disinfection; Environmental protection act and specifications for effluent of different food industries, treatment, reuse and disposal of solids and biosolids.	

Course Learning Outcomes:

- Understand the types of food industry waste and its treatment.
- Have practical knowledge about BOD as well as COD content of the waste water and its application in food industry.
- Apprehend various methods employed for the treatment of industrial wastes,
- Figure out methods for the utilization of industrial wastes and disposal of industrial wastes

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Metcalf & Eddy	Wastewater Engineering	McGraw Hill	2013	978-0073401188	2048

	treatment and Resource recovery, 5th edition				
Marriott N. G.	Principles of Food Sanitation, 5th edition	Springer; 6th ed.	2018	978-3319671642	437
Lawrence K. W., Howard H. Y. & Yapijakis C.	Waste Treatment in the Food Processing Industry	CRC Press	2005	978-0367392024	344
Loannis & Arvanitoyannis S.	Waste management for the food industries	Elsevier publishers.	2007	978-0123736543	1096

Baking and Confectionary Technology

L	T	P	SW/FW	Total Credit Units
3	0	0	0	3

Course content and syllabus

Baking and Confectionary Technology	Teaching Hrs
Unit I: Introduction to Bakery and Confectionary	**14 h**
Introduction to bakery and confectionery industries in India; Raw materials for bakery and confectionery products- essential and optional ingredients; Functionality of bakery ingredients; FSSAI specification of raw materials; Bakery equipments: divider, rounder, proofer, moulder; equipments used in baking, different types of ovens, slicer.	
Unit II: Bread Technology	**13 h**
Different types of bread and preparation of bread using different methods, quality evaluation of bread, bread faults and remedies, staling of bread, safety standards for bread industry; Preparation of other bakery products: buns, muffins and pizza.	
Unit III: Biscuits Technology	**14 h**
Biscuits: Types, methods of preparation and quality evaluation. **Cakes:** Types, methods of preparation and quality evaluation of cakes, cake faults and remedies, safety standards for biscuit and cake industry	
Unit IV: Confectionary	**13 h**
Confectionery- Raw materials, types, process, and machinery; **Types of candies:** boiled sweets, hard candy, brittle; **chocolates:** manufacturing process, quality consideration and parameters; Manufacturing process of toffees, caramels, lozenges, chewing gum, bars; Sugar free confectionary	

Course Learning Outcomes:

- Understand working operation of basic operation and working of various equipments involved in bakery and confectionary technology.
- Understand the various processes used for the manufacturing of bakery products like bread, biscuits, cakes, muffins and their quality determination.
- Acquire knowledge of the various processes used for the manufacturing of confectionary products like chocolate, candies, toffees, gums and their quality determination.
- Acquire knowledge on food safety rules and regulations for bakery and confectionary products

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Khatkar B. S.	Baking Science and Technology	Arihant Publication.	2011	9380872305	339
Amendola J. & Rees N.	Understanding Baking: The Art and Science of Baking	Willey	2003	978-0471405467	288
Manley D.	Technology of Biscuits,	CRC Press	2000	978-1845697709	632

	Crackers & Cookies. 2nd Edition				
Mohos F.	Confectionery & chocolate engineering, principles & applications	Wiley Blackwell Publishing Ltd.	2017	978-1118939772	792

Nanotechnology in Food Processing

L	T	P	SW/FW	Total Credit Units
3	0	0	0	3

Course content and syllabus

Nanotechnology in Food Processing	Teaching Hrs
Unit I: Introduction to food nanotechnology	**13 hrs**
Food nanotechnology: definitions, significance of field, brief historical perspectives/review, Physico-Chemical Nanoscale Properties of Foods; Processes impacting foods at nanoscale, Impacts of nanostructure and processes on food quality, processing, safety, and sensory properties; **Nano-engineered technologies for food:** Nanocarriers for Delivery of Bioactive Food Ingredient; Bioactive Food Ingredient and Nanocarriers; Release Mechanism of Bioactive Compound Form Nanocarriers.	
Unit II: Development of nanomaterial for food industry	**14 hrs**
Strategic Design of Delivery Systems for Nutraceuticals: Design of Delivery Vehicles for Nutraceuticals. **Nano emulsions**: components and Formation; use of nano emulsions in Food Industries; **Encapsulation systems:** Liposomes, micelles, polymerics, microemulsions; application of encapsulation technology in food industry; **Starch and non-starch nanoparticles:** Nanocellulose and food texture; Starch Nano Particles; Chitosan Nanoparticles; Phthalyl pullulan Nano Particles; Eudragit S100 Nanoparticles.	
Unit III: Nano antimicrobials in Food Industry	**13 hrs**
Nano antimicrobials in Food Industry: Nano antimicrobial Agents; Food Antimicrobial Nanocarriers; Application of Nano antimicrobials in Foods. **Nanotechnology in Food Packaging:** Bio nanocomposites for Food Packaging Applications, Polyhydroxyalkanoates in the Food Packaging Industry, applications in Food Packaging. **Nanotechnology on Health:** Nanostructures for probiotics and prebiotics.	
Unit IV: Nanotechnology for food toxicological analysis	**14 hrs**
Nanotechnology and Microbial Food Safety: Use of Nanotechnology and Nano sensors to detect food borne pathogens; Food Contaminants. Recent Advances in Molecular Techniques for the Diagnosis of Foodborne Diseases **Regulatory concerns:** Micro vs. nanoscale components and novel toxicity concerns; Submission of innovated nanotechnology to federal agency for use in food (FDA, EPA, USDA)	

Course Learning Outcomes:

1. Understand the impact of nanoscale on the quality parameters of foods.
2. Perceive the knowledge of various nanotechnology systems developed for food processing, preservation, and quality control.
3. Demonstrate the impact of nano-engineered technologies on food processing and quality parameters.
4. Acquire knowledge of nanotechnology systems approved by federal agencies for application in food.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Amparo Lopez Rubio; Maria Jose Fabra Rovira; Marta Martinez Sanz; Laura	Nanomaterials for food Applications	Elsevier Inc.	2019	978-0-12-814130-4	446

Gomez Gomez-Mascaraque					
V Ravishankar Rai Jamuna A. Bai	Nanotechnology Applications in the Food Industry	CRC Press Taylor & Francis Group	2018	978-1-4987-8483-2	557
C. Anandharamakrishnan and S. Parthasarathi	Food Nanotechnology Principles and Applications	CRC Press Taylor & Francis Group	2019	978-1-4987-6717-0	455
Research Papers					

Semester 8

B.Tech. Food Science Technology and Processing - 4 years (8th Semester)

B. Tech. Food Science Technology and Processing				Semester 8					
S. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1		Research Project	NTCC	0	0	18	0	0	18
2		Students will choose any two courses*							
		Food Biotechnology	OE	3	0	0	0	0	6
		Nutraceuticals & Functional Foods	OE	3	0	0	0	0	
		Agri Business Management	OE	3	0	0	0	0	
		Food Nutrition	OE	3	0	0	0	0	
				Total credits					24

Food Biotechnology

L	T	P	SW/FW	Total Credit Units
3	0	0	0	3

Course content and syllabus

Food Biotechnology	Teaching Hrs
Unit I: Introduction to food biotechnology	**14 hrs**
Introduction to food biotechnology, Vehicles for gene cloning, Plasmids, bacteriophages. Types of vectors, basics of genetic engineering	
Unit II: Transgenic plants	**13 hrs**
Transgenic plants- current status, direct and indirect methods: Direct methods- gene gun method, electroporation, chemical mediated gene transfer, micro injection and ultrasonic methods, Indirect methods- Agrobacterium mediated gene transfer; Molecular Farming; Transgenic plants for value added crops; Consumer perceptions for transgenic plants.	
Unit III: Transgenic animals	**14 hrs**
Transgenic Animals- Methods- physical and biological methods; Ethical, social and moral issues related to transgenic animals; Protein engineering in food technology– methods, objectives, limitations and applications of protein engineering (glucoseisomerase, lactobacillus β-galactosidase and peptide antibiotic nisin)	
Unit IV: Bacteriocins	**13 hrs**
Natural control of micro-organisms– bacteriocins of lactic acid bacteria, applications of bacteriocins in food systems; Biotechnology and food ingredients – biogums, bioflavours and biocolors.	

Course Learning Outcomes:

- Develop an understanding of genetic improvement of microorganisms for production of metabolites which can be used in field of food technology.
- Apprehend the methods of developing transgenic plants and animals.
- Understand ways and means of natural control of micro-organisms.
- Understand the importance, uses and the ways of production of biogums, bioflavours and biocolors

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Marwaha, S. S. & Arora, J. K.	Food Processing-Biotechnological applications	Asiatech Publishers Inc, New Delhi.	2000	978-8187680048	347
Joshi, V. K. & Pandey, A.	Biotechnology: Volume 1: Food Fermentation Microbiology, Biochemistry and Technology (Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology)	Educational publishers and Distributors.	1999	978-8187198048	574

Joshi, V. K. & Pandey, A.	Biotechnology: Food Fermentation Microbiology Biochemistry and Technology in 2 Vols (PB): Volume 2	Educational Publishers & Distributors	2009	978-8187198055	911
Lee, B. H.	Fundamentals of Food Biotechnology	John Wiley (WSE & Exclusive Indian Spl. Price Titles) 2014	2014	978-8126548866	
Tombs, M. P.	Biotechnology in Food Industry	Longman Higher Education	1991	978-0130837349	189
Goldberg, I. & Williams, R.	Biotechnology and Food Ingredients	Van Nostrand Reinhold, New York.	1991	978-0442002725	578

Nutraceuticals & Functional Foods

L	T	P	Total Credit Units
3	0	0	3

Course content and syllabus

Nutraceuticals & Functional Foods	Teaching Hrs
Unit I: Basics of nutraceutical & functional foods	**14 hrs**
Basics of nutraceutical & functional foods: Defining nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods; Nutraceutical and functional food applications and their health benefits; Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions; Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc.	
Unit II: Major nutrients as nutraceuticals and functional foods	**13 hrs**
Proteins, Carbohydrates & Fats as functional foods & Nutraceuticals; Proteins as functional food ingredients i.e. whey proteins, soya proteins etc; Complex carbohydrates and Fibres as functional food ingredients; Antioxidants and other phytochemicals, (isoflavones, lycopenes), phytosterols and their role as nutraceuticals and functional foods; Oils with MUFA, n3 & n6 PUFA as nutraceuticals & functional foods	
Unit III: Foods as nutraceutical & functional foods	**14 hrs**
Foods as nutraceutical & functional foods: Probiotic foods and their functional role; Cereal products as functional foods - oats, wheat bran, rice bran etc.; Functional vegetable products i.e. vegetables and fruits, oil seeds etc; Sea foods; Fat replacers Beverages such as green tea, coffee, cocoa, fruit juices as functional foods and their protective effects; Herbs as functional foods, health promoting activity of common herbs	
Unit IV: Future of nutraceuticals & functional foods	**13 hrs**
Future of nutraceuticals & functional foods; Recent developments and advances in the areas of nutraceutical and functional foods and their role in nutrigenomics in health care.	

Course Learning Outcomes:

- Understand the nature, type and scope of nutraceutical and functional foods.
- Apprehend the role of proteins, carbohydrates & fats as functional foods & nutraceuticals.
- Understand the health promoting benefits of various foods and beverages.
- Predict the future of nutraceuticals and functional foods.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Mazza, G	Functional foods – biochemical and processing aspects	CRC Press Inc	1988	978-1566769020	428

Kirk, RS	Pearson's composition and analysis of foods	Wesley Longman Inc. California, USA	1999	978-0582409101	720

Agri Business Management

L	T	P	Total Credit Units
3	0	0	3

Course content and syllabus

Agri Business Management	Teaching Hrs
Unit I: Introduction to agri-business management	**14 hrs**
Introduction; Definition, History, objectives, importance in respect to Indian economy and globalization. Management of agribusiness; Agricultural and food policy, Rural Management. New product development: introduction, new product development, Value analysis, Quality management, quality control and improvement, process selection. Forecasting; new business forecasting, cost forecasting, product forecasting, Food commodity trading	
Unit II: Marketing management	**13 hrs**
Marketing Management; Role of Management in agribusiness, attributes of manager, responsibility of manager. Marketing of agricultural input and marketing of agricultural product. Market research for agribusiness. Different type of management in agribusiness; Production management, retail and supply chain management, inventory management (Introduction, functions, attributes, needs). Legal aspects of small Business; Elementary knowledge of Income Tax, Sales Tax, Patent Rules, Excise Rules, Factory Act and Payment of Wages Act etc.	
Unit III: Entrepreneurship Development Programs	**14 hrs**
Entrepreneurship Development Programs (EDP); Meaning, characteristics and functions of an entrepreneur, SWOT analysis of new industries and new products. Government schemes and incentives for promotion of entrepreneurship. Government policy on small and medium enterprises (SMEs)/ Small Scale industries (SSIs). Export and Import Policies relevant to Food Processing Sector. Venture capital, contract farming and joint ventures. Public-private partnership (PPP). Characteristics of Indian food processing Industry. Social responsibility of food processing business.	
Unit IV: World trade agreements	**13 hrs**
World trade agreements related with food business, export trends and prospects of food products in India. Consumer Behavior towards Food Consumption, Consumer Surveys by various Institutes and Agencies. Govt. institutions related to international trade; APEDA, Tea board, spice board, wine board, MOFPI etc. Management of export import organization; registration, documentation, export import logistics, Export and import policies relevant to horticultural sector. World Food Day - importance and action plans.	

Course Learning Outcomes:

- Understand the importance of various aspects agribusiness management.
- Able to introduce new product and its marketing strategies.
- Will guidance entrepreneurs in legal matters and tax management.
- Able to handle the import and export of various commodities.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Greg A. Baker, Orlen Grunewald, William D. Gorman	Introduction to food and agribusiness management	Pearson	2001	978-0130145772	384
Khanks S.S.	Entrepreneurial Development	S. Chand and company New Delhi	2007	978-8121918015	794
Acharya SS and Aggarwal N L	Agricultural Marketing in India	CBS Publishers & Distributors	2021	978-9389688061	556
Edward W. Cundiff	Marketing in the International Environment	Prentice Hall of India, New Delhi	1993	978-0135573495	608

Food Nutrition

L	T	P	SW/FW	Total Credit Units
3	0	0	0	3

Course content and syllabus

Food Nutrition	Teaching Hrs
Unit I: Scope, concepts and importance of nutrition	**14 hrs**
Scope, concepts and importance of nutrition; definition of various terms related to nutrition, food, nutrients, health, human digestive system; nutrients: classification, functions, sources & requirement of carbohydrates, proteins, lipids, water, vitamins and minerals and deficiency	
Unit II: Concepts of energy	**13 hrs**
Energy - definition, units of measurement of energy, basal metabolic rate (BMR), specific dynamic action (SDA) of foods, factors affecting BMR and respiratory quotient (RQ), Balanced diets, recommended dietary allowance (RDA) reference man and woman, diets for different age groups, role of diet in diseases; dietary Fiber and their functions.	
Unit III: Introduction to nutrition	**14 hrs**
Nutrition - role of nutrition in pregnancy and lactation, infant nutrition, childhood nutrition, geriatric nutrition; Nutrition of special groups (space, sports): significance, factors to be considered while planning diets for sports persons; Malnutrition and its types, epidemiology of under nutrition and over nutrition, nutrition infection and immunity, nutrition education	
Unit IV: Organizational status for health and nutrition	**13 hrs**
Role of different organizations in maintaining health and nutritional status, national and international agencies; nutritional policies like food for work, mid-day meals, integrated child development services (ICDS) vitamin A and Iron, prophylaxis, measures; Existing food fads and fallacies & how to overcome	

Course Learning Outcomes:

- Comprehend various aspects of food nutritional requirements and concept of balance diet.
- Understand the physiological and metabolic functions of nutrients.
- Understand the health benefits of foods.
- Apprehend the nutritional daily requirements of various age groups as per ICMR

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Joshi S. A.,	Nutrition and Dietetics	Tata Mc Grow-Hill publishing Company Ltd., New Delhi	2017	978-9339220150	676

M. Swaminathan	Advanced Textbook on Food & Nutrition Volume-2	THE BANGALORE PRESS	2015	978-1761362804	630
Mann J., and Truswell S	Essentials of Human Nutrition 3rd Ed	Oxford University Press, 2007	1998	978-0192627568	658
Eastwood M. S.	Principles of Human Nutrition 2 ed	Blackwell Publishers	2003	978-1405120296	688