

Semester-Wise Programme structure for B.Sc. FSTP [4 year] with Research								
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	Fundamentals of Food Technology (FST101) [CU:6; L-4, P-2] {CC}	Technology of Cereals, Pulses and Oilseeds-I (FST104) [CU:6; L-4, P-2] {CC}	Food Microbiology-I (FST205) [CU:6; L-4, P-2] {CC}	Food Microbiology-II (FST206) [CU:6; L-4, P-2] {CC}	Technology Of Milk Products Processing (FSTXX) [CU:6; L-4, P-2] {CC}	Malting & Brewing Technology (FSTXX) [CU:6; L-4, P-2] {CC}	Nutraceuticals and Functional Foods (FSTXXX) [CU:4; L-4, P-0] {CC}	Industrial Microbiology (FSTXX) [CU:4; L-4, P-0] {CC}
2	Food Processing and Preservation (FST103) [CU:6, L-4, P-2] {CC}	Technology of Fruits, Vegetables and Plantation Crops (FST105) [CU:6; L-4, P-2] {CC}	Technology Of Cereal Pulses and Oilseeds - II (FST201) [CU:6; L-4, P-2] {CC}	Food Engineering (FST207) [CU:6; L-4, P-2] {CC}	Food Packaging (FSTXX) [CU:6; L-4, P-2] {CC}	Food Safety and Laws (FSTXX) [CU:6; L-4, P-2] {CC}	Enzymes in Food Processing (FSTXXX) [CU:4; L-4, P-0] {CC}	Any one from a and b; a) Emerging Biochemical and Biophysical Techniques (FSTXX) [CU:4; L-4, P-0] {SE}
3	Fundamental of Food Chemistry (NUD103) [CU:4, L-3, P-1] {AC}	Advanced Food Chemistry (FST108) [CU:4, L-3, P-1] {AC}	Technology of Egg, Poultry, Meat and Sea Food (FST203) [CU:6; L-4, P-2] {CC}	Food Quality Assurance (FST208) [CU:6; L-4, P-2] {CC}	(Any two from a-d) a) Crop Science (FSTXX) [CU:4; L-4, P-0] {SE}	(Any two from a-d) a) Food Plant Sanitation (FSTXX) [CU:4; L-4, P-0] {SE}	Any one from a and b; a) *Biochemical & Biophysical Techniques (FSTXXX) [CU:4; L-4, P-0] {OE}	b) Advanced Food Preservation Technology (FSTXX) [CU:4; L-4, P-0] {SE}

							*Tentative	
4	Behavioral Skills (PSY101) [CU:1, L-1, P-0] {VAC}	Behavioural Skills (PSY101) [CU:1, L-1, P-0] {VAC}	Sensory Evaluation of Food (FST204) [CU:3; L-3, P-1] {AC}	Food Quality Management (FST205) [CU:4; L-4, P-0] {AC}	b) Confectionary Technology [CU:4; L-3, P-1] {SE}	b) Bakery Technology (FSTXX X) [CU:4; L-3, P-1] {SE}	b) *Recombinant DNA Technology (FSTXXX) [CU:4; L-4, P-0] {OE} *Tentative	Any one from a and b; a) *IPR, Biosafety and Bioethics [CU:4; L-4, P-0] {OE} *Tentative
5	Communication Skills (ENG101) [CU:1, L-1] {VAC}	Communication Skills [CU:1, L-1] {VAC}			c) Principles of Fermentation Technology [CU:4; L-4, P-0] {SE}	c) Technology of Frozen Foods (FSTXX X) [CU:4; L-4, P-0] {SE}		b) *Plant Biotechnology [CU:4; L-4, P-0] {OE} *Tentative
6	Introduction to French Culture & Language (FOL101)/ Introduction to German Culture & Language (FOL102) [CU:1,	German Grammar / French Grammar (FOLXX X) [CU:1, L-1] {VAC}			d) Spices and Flavour Technology [CU:4; L-4, P-0] {SE}	d) Technology of Snack Foods (FSTXX X) [CU:4; L-4, P-0] {SE}		

	L-1] {VAC}							
7	Environmental Science (ENV101) [CU:2, L-2] {AEC}	Environmental Science [CU:2, L-2] {AEC}						
8	Punjabi (INL101)/ History and Culture of Punjab for BSc (INL103) [CU:1, L-1] {AEC}	Punjabi Language/Punjab History & Culture [CU:1, L-1] {AEC}			Bioentrepreneurship/ MOOCs [CU:2, L-2] {SEC}	Biosensors/MOOCs [CU:2, L-2] {SEC}		
9	Mathematics for Biosciences/MOOCs (XXX) [CU:2, L-2] {SEC}	Statistics for Biosciences/MOOCs [CU:2, L-2] SEC}	Programming with C/MOOCs [CU:2, L-1, P-1] {SEC}	Food Product Development (FST205)/MOOCs [CU:2; L-2, P-0] {SEC}	Programming in Python Lab/MOOCs [CU:2, L-0, P-2] {SEC}	Research Methodology/MOOCs [CU:2, L-2] {SEC}	Dissertation/thesis work [CU:12; L-0, P-12] {NTCC}	Dissertation/thesis work [CU:12; L-0, P-12] {NTCC}
Credits	24	24	24	24	24	24	24	24
Total Programme Credits								192

B.Sc. (Hons.) Food Science Technology and Processing (4 year)

B.Sc. (H) Food Science Technology and Processing (4 year)

Semester-wise Distribution of Courses				1 st Semester					
S. No.	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1	FST101	Fundamentals of Food Technology	Core Course	4	0	2	0	0	6
	FST103	Food Processing and Preservation	Core Course	4	0	2	0	0	6
2	NUD103	Fundamental of Food Chemistry	Allied course	3	0	1	0	0	4
5	PSY101	Behavioural Skills	Value Addition Course	1	0	0	0	0	1
	ENG101	Communication Skills	Value Addition Course	1	0	0	0	0	1
	FOL101/ FOL102	Foreign Business Language	Value addition Course	1	0	0	0	0	1
7	INL101/ INL102	Punjabi Language and Literature-1/Punjab History & Culture	Ability Enhancement Courses	1	0	0	0	0	1
	ENV101	Environmental Science	Ability Enhancement Courses	2	0	0	0	0	2
9	STA101	Mathematics for Biosciences	Skill Component	2	0	0	0	0	2
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.

Fundamentals of Food Technology

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course content and syllabus

COURSE CODE: FST101 (Fundamentals of Food Technology)	Teaching Hrs
Unit I: Introduction: History and evolution of food processing technology	18 h
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 and Oilseeds, Fruits and Vegetables	18 h
Pulses: Structure and composition of pulses, antinutritional constituents, soaking, germination, decortication, cooking and fermentation. Fats and Oils : Classification and types of lipids, Refining of oils, methods of refining, advantages and disadvantages, hydrogenation, Rancidity-Types and prevention, 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	18 h
Milk: Definition of milk, chemical composition of milk, its constituents, Processing of milk: pasteurization, homogenization, an overview of types of market milk and milk product.	
Unit IV: Compositional, Nutritional and Technological aspects of Animal foods	18 h
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.	

Lab/ Practical details: (72 Hours)

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. 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

Food Processing and Preservation

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course content and syllabus

COURSE CODE: FST103 (Food Processing and Preservation)	Teaching Hrs
Unit I: Food Processing Operations	18 h
<p>Refrigeration and Freezing: Requirements of refrigerated storage-controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing</p> <p>Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.</p> <p>Dehydration: Normal drying curve, effect of dehydration on food properties, change in food during drying, drying methods and equipments; air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, dryer, drum dryer, vacuum dryer, freeze drying, foam mat drying.</p> <p>Thermal Processing of Foods: Classification of thermal processes, Principles of thermal processing, commercial canning operations, Aseptic Processing, UHT.</p> <p>Irradiation and microwave heating: Principles, Dosage, Applications of Irradiation, Mechanism of microwave heating and applications</p>	
Unit II: Technology of Colloids in Food	18 h
Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agents, food foams, formation stability and destruction of foam, application of colloidal chemistry to food preparation	
Unit III: Wastewater management and minimal processing and hurdle technology in food industry	18 h
<p>Water Disposal and Sanitation Wastewater, hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, wastewater treatment, milk plant sanitation, CIP system sanitizers used in food industry.</p> <p>Minimal processing and hurdle technology: Contaminants and Regulations</p>	
Unit IV: Food Additives and Contaminants	18 h
<p>Food Additives: Introduction, need of food additives in food processing and preservation, Characteristics and classification of food additives, Chemical, technological and toxicological aspects.</p> <p>Contaminants in Food: Contamination in Food Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionuclides, solvent residues, chemicals) Natural toxins. Food Laws and Regulations- Codex, HACCP, ISO, FSSAI</p>	

Lab/ Practical details:

(72 Hours total)

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. Canning of foods
2. Preservation of food by the process of freezing
3. Drying of food using Tray dryer/other dryers
4. Estimation of Chemical Oxygen Demand (Demonstration)
5. Preparation of brix solution and checking by hand refractometer
6. Analysis of water
7. Minimal Processing of food
8. Application of colloidal chemistry in food preparation

Course Learning Outcomes:

- Understanding the methods of food preservation
- Demonstrate food preservation by canning method
- Compare the flavour and sensory of beer and other alcoholic/non-alcoholic beverages
- Perceive knowledge of food additives, food contaminations, and health-related issues

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

Fundamental of Food Chemistry

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

Course content and syllabus

Fundamental of Food Chemistry	Teaching Hrs
Unit I: Water, water activity and shelf-life of food	14 h
Water: Definition of water in food, Structure of water and ice, Types of water, Sorption phenomenon, Water activity and packaging, Water activity and shelf-life	
Unit II: Classification and structure of carbohydrates and Proteins	13 h
Carbohydrates: Classification, Structure of important polysaccharides, Chemical reactions of carbohydrates –oxidation, reduction, with acid & alkali modified celluloses and starches Proteins: Protein classification and structure, Nature of food proteins (plant and animal proteins), Properties of proteins (electrophoresis, sedimentation, amphoterism and denaturation), Functional properties of proteins.	
Unit III: Classification and Technology of edible fats and oils	14 h
Lipids: Classification and physical properties of lipids. Chemical properties of lipids Effect of frying on fats Changes in fats and oils: rancidity, lipolysis, flavor reversion, Auto-oxidation and its prevention, Technology of edible fats and oils: Refining, Hydrogenation and Interesterification, Fat mimetics	
Unit IV: Introduction to vitamins and flavors	13 h
Vitamins: Structure, Importance and Stability, Water soluble vitamins, Fat soluble vitamins, Flavor Flavors: Definition and basic tastes, chemical structure and taste, description of food flavors and flavor enhancers	
Words (2021-2025): 189; Words (20222026): 179	

Lab/ Practical details: (36 Hours total)

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) Preparation of primary and secondary solutions
- 2) Estimation of moisture content
- 3) Estimation of reducing and non-reducing sugars using potassium ferricyanide method and DNS method.
- 4) Estimation of protein content in the flours of cereals and pulses by spectrophotometric methods.
- 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) Estimation of saponification value

Course Learning Outcomes:

- Understand the basic chemical structure of the major components of foods (water, proteins, carbohydrates, and lipids).
- Determine major food components like starch protein and fats
- Compare the effect of processing on the composition of raw and processed food.
- Perceive basic knowledge about the chemical structure of various flavor components

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
Wong, Dominic W. S.	Food Enzymes: Structure and Mechanism	New York: Springer,	2011	9781441947222, 1441947221	406

COURSE CODE: PSY101 (Understanding Self for Effectiveness)

L	T	P	Total Credits
1	0	0	1

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
Singh A.	Achieving Behavioural Excellence for Success	Wiley Publication	2012	978812658027
Towers, Marc	Self Esteem	American Media	1995	9781884926297
Pedler Mike, Burgoyne John, Boydell Tom	A Manager's Guide to Self-Development	McGraw-Hill	2006	978-0077114701
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	Living with E.I	Bantam Books	1998	9780553104622

Communication Skills-I

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

COURSE CODE: ENG101 (Communication Skills-I)	Teaching Hrs
Unit I: Basic Concepts in Communication	3.5 h
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 h
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 h
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 h
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 communicative competence thereby for effective communication.

Books/literature

Author	Title	Publisher	Year of publication	ISBN
P. D. Chaturvedi and Mukesh Chaturvedi	Business Communication: Concepts, Cases and Applications	Pearson Education	2006	9788131701720
Meenakshi Raman and Prakash Singh	Business Communication	Oxford University Press	2012	9780198077053
Jeff Butterfield	Soft Skills for Everyone	Cengage Learning	2017	9789353501051

Introduction to French Culture & Language

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

<u>COURSE CODE: FOL101 (Introduction to French Culture & Language)</u>	Teaching hours
Unit-I Introduction to French language	3 h
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 h
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 h
Description of objects, people and places, Nationalities, Speaking about one's professions, Expressing Actions using regular –er ending verbs; avoir, être; reflexive verbs – usage, conjugation, Interview of celebrity	
Unit-IV- At the discotheque	4.5 h
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
Christine Andant, Chaterine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1 Livre De L'Eleve, Cahier D' Exercices	Langers International Private Limited	2010	978- 9380809069
Manjiri Khandekar and Roopa Luktuke	Jumelage - 1 Methode De Fraincais - French	Langers International Private Limited	2020	978- 9380809854
Michael Magne, Marie- Laure Lions-Olivieri	Version Originale 1: Cahier d'exercices	Maison Des Langues	2010	97884844356 17

Introduction to German Culture & Language

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

COURSE CODE: FOL102 (Introduction to German Culture & Language)	Teaching Hrs
Unit-I Introduction to German Language (Einführung)	3 h
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 h
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 h
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 h
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

Rolf Bruseke	Starten Wir A 1	Langers International Pvt Ltd (Max Hueber Verlag)	2017	978- 319016 0006
Giorgio Motta	Wir Plus Grundkurs Deutsch für Junge Lerner Book	Ernst Kleit Verlag	2011	978- 818307 2120
Heimy Taylor, Wern er Haas	Station en Deutsch Self Study Course German Guide	Wiley	2007	978- 047016 5515

Environmental Studies-I

L	T	P	Total Credits
2	0	0	2

Course Contents/syllabus:

COURSE CODE: FOL101 (Environmental Studies-I)	Teaching Hrs
Unit-I: Multidisciplinary nature of environmental studies	9 h
Multidisciplinary nature of environmental studies: Definition, scope and importance; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Concept of sustainability and sustainable development.	
Unit-II: Ecosystems	9 h
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-III: Natural Resources	9 h
Natural resources: Land resources and land use change, land degradation, soil erosion and desertification. 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-IV: Biodiversity and its conservation	9 h
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: At the end of this course, the students will be able to develop:

- Appreciate the multi-disciplinary nature of environmental science
- 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
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 2 nd edition	Blackwell Publishing	2004	978-1-405-11857-6

Punjabi Language and Literature-1

L	T	P	Total Credits
1	0	0	1

Course content and syllabus:

Punjabi Language and Literature-1 Subject Code- INL 10	Teaching Hours
Unit I:	4 hours
ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਅਧਿਐਨ (ਕਾਵਿ-ਸੁਮੇਲ ਪਾਠ-ਪੁਸਤਕ) ਕਵਿਤਾ ਦਾ ਸਾਰ/ਕੇਂਦਰੀ ਭਾਵ ਅਤੇ ਪ੍ਰਸੰਗ ਸਾਹਿਤ ਵਿਆਖਿਆ ਕਵੀ ਦੇ ਜੀਵਨ ਅਤੇ ਸਾਹਿਤਕ ਯੋਗਦਾਨ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ	
Unit II:	4 hours
1. ਲੇਖ-ਰਚਨਾ ਲੇਖ-ਰਚਨਾ: ਮਹੱਤਵ, ਕਿਸਮਾਂ ਅਤੇ ਵੱਖ-ਵੱਖ ਵਿਸ਼ਿਆਂ ਅਨੁਸਾਰ ਵਿਹਾਰਕ ਅਭਿਆਸ 2. ਸੰਖੇਪ-ਰਚਨਾ ਸੰਖੇਪ-ਰਚਨਾ: ਮਹੱਤਵ ਅਤੇ ਤਕਨੀਕ	
Unit III:	5 hours
ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ: 1. ਵਿਆਕਰਨ: ਪਰਿਭਾਸ਼ਾ; ਮਹੱਤਤਾ; ਉਦੇਸ਼; ਵਿਆਕਰਨ ਦੇ ਅੰਗ 2. ਪੰਜਾਬੀ ਧੁਨੀਵਿਓਂਤ: ਸ਼੍ਰੀ ਅਤੇ ਵਿਅੰਜਨ ਧੁਨੀਆਂ ਦਾ ਵਰਗੀਕਰਨ, ਉਚਾਰਨ ਅੰਗ	
Unit IV:	5 hours
ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ: ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ: ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਪ੍ਰਕਾਰ ਨਾਂਵ, ਪੜਨਾਂਵ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ, ਸਬੰਧਕ, ਯੋਜਕ ਅਤੇ ਪ੍ਰਸ਼ਨ-ਸੁਚਕ ਸ਼ਬਦ	

Course Learning Outcomes:

1. Understand modern Punjabi Poetry.
2. Interpret the importance of essay and precise writing
3. Analyze the Punjabi language structure and grammar.
4. Examine the impact and importance of grammar and language structure.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
ਡਾ. ਕਰਮਜੀਤ ਸਿੰਘ (ਸੰਪਾ.),	ਕਾਵਿ ਸੁਮੇਲ	ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਚੰਡੀਗੜ੍ਹ	2020	-	-
ਸੁਰਿੰਦਰ ਸਿੰਘ ਖਹਿਰਾ (ਸੰਪਾ.),	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਆਕਰਨ ਅਤੇ ਬਣਤਰ	ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਪਟਿਆਲਾ	2015	-	-
ਡਾ. ਹਰਕੀਰਤ ਸਿੰਘ,	ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ	ਪੰਜਾਬ ਸਟੇਟ ਯੂਨੀਵਰਸਿਟੀ ਟੈਕਸਟ ਬੁੱਕ ਬੋਰਡ, ਚੰਡੀਗੜ੍ਹ	1999	-	-

	ਅਤੇ ਲੇਖ ਰਚਨਾ				
ਡਾ. ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼ ਸਿੰਘ	ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਅਤੇ ਲੇਖ ਰਚਨਾ	ਮਦਾਨ ਪਬਲੀਕੇਸ਼ਨਜ਼, ਪਟਿਆਲਾ	2002	-	-
ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ	ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ	ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਪੰਜਾਬੀ ਭਵਨ, ਲੁਧਿਆਣਾ	2012	-	-
ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਸ਼੍ਰੇਣੀ ਅਤੇ ਸਰੂਪ	, ਵਾਰਿਸ ਸ਼ਾਹ ਫ਼ਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ	2012	-	-
ਦੁਨੀ ਚੰਦ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਣ	, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਚੰਡੀਗੜ੍ਹ	1995	-	-
ਜੋਗਿੰਦਰ ਸਿੰਘ ਪੁਆਰ ਅਤੇ ਹੋਰ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਨ (ਭਾਗ 1,2,3),	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	2003	-	-
ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	2010	--	-
ਅਗਨੀਹੋਤਰੀ, ਵੇਦ	ਪਰਿਚਾਇਕ ਭਾਸ਼ਾ ਵਿਗਿਆਨ	ਦੀਪਕ ਪਬਲਿਸ਼ਰਜ਼ ਜਲੰਧਰ	1981		

History and Culture of Punjab

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus

COURSE CODE: FOL102 (History and Culture of Punjab)	Teaching Hrs
Unit I:	4.5 h
Harappan Civilization: extent and town planning and socio-economic life. Life in Vedic Age: socio-economic and religious; Growth and impact of Jainism and Buddhism in Panjab.	
Unit II:	4.5 h
Society and Culture under Maurayas and Guptas. Bhakti movement: Main features; prominent saints and their contribution. Origin and development of Sufism	
Unit III:	4.5 h
Evolution of Sikhism: teaching of Guru Nanak; Institutional Development- Manji, Masand, Sangat and Pangat. Transformation of Sikhism: Martyrdom of Guru Arjan; New policy of Guru Hargobind, martyrdom of Guru Tegh Bahadur. Institution of Khalsa: New baptism; significance	
Unit IV:	4.5 h
Changes in Society in 18th century: social unrest; emergence of misls and other institutions - rakhi, gurmata, dal khalsa. Society and Culture under Maharaja Ranjit Singh. MAP (of undivided physical geographical map of Punjab): Major Historical Places: Harappa, Mohenjodaro, Sanghol, Ropar, Lahore, Amritsar, Kiratpur, Anandpur Sahib, Tarn Taran, Machhiwara, Goindwal, Khadur Sahib.	

Course Learning Outcomes:

- Understand the history of various cultures in Punjab.
- Interpret the importance of Maurayan,
- Gupta and Bhakti influences on Punjab
- Apply the teaching of Sikhism on the emergence of the Khalsa.
- Examine the impact societal changes on socio-cultural and physical landscape of Punjab

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No
L.M Joshi,	History and Culture of the Punjab, Part-I	Punjabi University, Patiala	1989,3 rd	-
Buddha Prakash	Glimpses of Ancient Punjab	Punjabi University, Patiala,	1983	-
Khushwant Singh	A History of the Sikhs, vol I: 1469-1839,	oxford University Press, Delhi	1991	-

Mathematics for Biosciences

L	T	P	TOTAL CREDIT UNITS
2	0	0	2

Course Contents/syllabus:

Mathematics for Biosciences	Teaching Hours
Unit I: Sets, Relations and Function	9h
Sets and their properties, Cartesian product of Sets, relations, functions and their types and graphs	
Unit II: Matrix Algebra	9h
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 and system of linear equations	
Unit III: Differential Calculus	9h
Algebra of limits, Continuity, Derivative of a function, Fundamental rules for differentiation, increasing and decreasing functions, Introduction to Partial derivatives	
Unit IV: Integral Calculus	9h
Indefinite and definite integrals, methods of Integration, Properties of definite integrals	

Course Learning Outcomes: On the successful completion of this course

- 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 apply the concept of matrices in real-life situations
- Students will understand the concepts of Limits, Continuity and Differentiability and their applications
- Students will understand and analyze the concept of Integration with the help of Differentiation and study its various applications

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN
George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir	Thomas' Calculus (14th edition)	Pearson Education	2018	978-9353060411
H.K. Dass	Higher Engineering Mathematics	S. Chand	2014	978-8121938907

Semester 2

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				2nd Semester					
S. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	F W	S W	
1	FST104	Technology of Cereals, Pulses and Oilseeds-1	Core Course	4	0	2	0	0	6
2	FST105	Technology of Fruits, Vegetables and Plantation Crops	Core Course	4	0	2	0	0	6
3		Advanced Food Chemistry	Allied course	3	0	1	0	0	4
4		Behavioural Skills	Value Addition Course	1	0	0	0	0	1
5		Communication Skills	Value Addition Course	1	0	0	0	0	1
6		German Grammar/ French Grammar	Value addition Course	1	0	0	0	0	1
7		Punjabi Language and Literature-2/Punjab History & Culture	Ability Enhancement Courses	1	0	0	0	0	1
8		Environmental Science	Ability Enhancement Courses	2	0	0	0	0	2
9		Statistics for Biosciences	Skill Component	2	0	0	0	0	2
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.

Technology of Cereals, legumes, and Oil Seeds - I

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Technology of Cereals, legumes, and Oil Seeds - I	Teaching Hrs
Unit I: Wheat production, varieties, and their quality	18 h
<p>Wheat: Production, varieties, and their quality. Structure and composition, environmental effect in relation to processing quality, Enzyme in wheat and their implications in wheat technology.</p> <p>Types of wheat grading system, Cleaning, conditioning and milling of wheat.</p> <p>Principles and machine operations, Fractionation of flour and its application. Flour treatment. Technology of bakery product such as bread, biscuits, cake, crackers, pretzel, etc. Production, equipment, and ingredients.</p> <p>Role of ingredients in bakery products.</p>	
Unit II: Quality evaluation of wheat and wheat products	18 h
<p>Criteria of quality evaluation of flour. Introduction to dough rheology and dough chemistry, Testing properties of flour slurry and dough using instruments–Farinograph, Falling Number, Extensiograph, Amylograph, Mixograph, Rapid Visco Analyser, Alveograph etc.</p> <p>Industrial processes for the production starch and gluten from wheat. Functional properties and uses of wheat starch, chemistry and technology of durum wheat and pasta products.</p>	
Unit III: Rice production, varieties, and rice products	18 h
<p>Rice production, rice types. Rice structure and proximate composition, distribution of various chemical constituents in rice grain. Production of rice starch, uses and evaluation of functional properties of rice starch. Methods of studying quality of rice with special reference to cooking quality. Changes during aging of rice. Methods of accelerated aging of rice. Methods of enrichment with vitamins and mineral.</p>	
Unit IV: Rice Processing Technology	18 h
<p>Rice milling, operation, milling machine, degree of Milling, milling yields of paddy.</p> <p>Factors affecting milling yield and Milling effect on nutrition and quality of rice. Rice bran stabilization, methods of stabilization, Methods of parboiling, controlling the degree of parboiling, nutrition, advantages and disadvantages. Technologies of quick cooking rice, infant foods, rice flakes and breakfast cereals. Rice in brewing and manufacture of beer. Manufacturing of ready to eat cereals: flakes, gun puffed, extruded and shredded grains.</p>	

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 (Hours)

(72

1. Milling of rice and assessment of per cent of head, broken, immature kernels degree of polish etc.
2. Parboiling and evaluation of quality of parboiled rice.
3. Evaluation of cooking quality of rice.
4. Determination of quality characteristics of flours.
5. Rheological properties of dough using Farinograph/ Extensograph/Mixograph.
6. Pasting properties of starches using Visco–amylograph/RVA.

7. Baking of bread, cookies and cakes and evaluation of their quality.
8. Processing of paste goods and evaluation of their quality.
9. Visit to wheat and rice, processing plants.

Course Learning Outcomes:

- Learning of the processing of wheat and rice.
- Demonstrate quality evaluation of wheat flour and functionality of rice starch by different methods.
- Compare different rice processing methods
- Perceive knowledge of product development from wheat flour.

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
Manay, S. and Sharaswamy, M.	Food Facts and Principles.	Wiley Eastern Limited.	2020	9789389802405	574
Marshall.	Rice Science and Technology	Wadsworth Ed. New York: Marcel Dekker.	1993	9780824788872	486

Technology of Fruit Vegetable and Plantation Crops

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Technology of Fruit Vegetable and Plantation Crops	Teaching Hrs
UNIT I: Understanding composition and preservation of Fruits and Vegetables	18 h
Importance of fruits and vegetable, History and need of preservation, reasons of spoilage. Method of preservation (short & long term). Fruit Maturity - Definition, methods of maturity determination, maturity indices for selected fruits and vegetables. Chemical changes during maturation. Canning and Bottling of Fruits and Vegetables Selection of fruits and vegetables, Process of canning, factors affecting the process- time and temperature, Containers of packing, lacquering, Syrups and brines for canning, Spoilage in canned foods	
UNIT II: Fruit Beverages	18 h
Fruit Beverages Introduction, reasons of spoilage Processing of fruit juices- selection, juice extraction, deaeration, straining, filtration and clarification. Preservation of fruit juices- pasteurization, chemically preserved with sugars, freezing, drying, tetra-packing, carbonation. Processing of squashes, cordials, nectars, concentrates and powder. Packaging of fruit beverages.	
UNIT III: Jams, Jellies and Marmalades	18 h
Jams, Jellies and Marmalades: Introduction Jam: Constituents, selection of fruits, processing & technology. Jelly: Essential constituents, Theory of jelly formation, Processing & technology, defects in jelly. Marmalade: Types, processing & technology, defects. Packaging of jams, jellies and marmalades Pickles and Tomato Products Pickles - Processing and Types, Causes of spoilage in pickling. Tomato products -Selection of tomatoes, pulping & processing of tomato juice. Tomato puree, paste, ketchup, sauce and soup. Packaging of pickles and tomato products	
UNIT IV: Dehydration of Fruits and Vegetables	18 h
Dehydration of Fruits and Vegetables: Sun drying & mechanical dehydration, Process variation for fruits and vegetables Spices: Processing and properties of major and minor spices Essential oils & oleoresins Tea, Coffee and Cocoa: Processing, Variety and Products.	

Lab/ Practical details:

(72 Hours)

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 Practical's

- 1) Estimation of total soluble solids, pH, acidity, brix to acidity ratio, ascorbic acid in food

- 2) Steps in canning process.
- 3) Making and evaluation of pectin and tomato products.
- 4) Drying and rehydration of fruits and vegetables.
- 5) Extraction and estimation of polyphenol content in tea and coffee.
- 6) Spices and adulteration.

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
- Training to prepare jams, jellies, and marmalades from seasonal fruits.
- Gaining in-depth knowledge of drying vegetables and fruits by different methods, and storage.
- Knowing about tea coffee production, processing and flavor and aroma determination.

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

Advanced Food Chemistry

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

Course Contents/syllabus:

Advanced Food Chemistry	Teaching hours
Unit I Nucleic acids: structure, biosynthesis, and regulation	14 h
Nucleotides and nucleic acids: Nucleotide and Nucleic Acid Nomenclature, Structure, Comparison of A, B, and Z forms of DNA, Function, Biosynthesis of purines and pyrimidines nucleotides, regulation of nucleotide biosynthesis. DNA Replication and Damage Repair RNA: Characteristics, Structure, Function, Types, Transcription, and translation	
Unit II Nutraceuticals, functional foods, and food additives	13 h
Nutraceuticals and functional foods: Difference, types, bioactive components, benefits, health claims and food applications Food additives: types, classification, and respective uses in processed foods Antinutritional factors: types, sources, and health hazards	
Unit III Protein synthesis and enzyme kinetics	14 h
Protein: Protein Synthesis, post-transcriptional and post-translational regulation, Post translation modification in proteins. Enzymes: Introduction, types, characteristics; Enzyme kinetics; application of enzymes in food processing	
Unit IV Pigments, vitamins, flavour, and minerals	13 h
Natural Food Pigments: Introduction, classification, Food pigments, effect of different processing methods on pigments. Minerals: Major and minor minerals; Metal and toxic metals Fat- and water-soluble vitamins: types and related deficiencies, effects of processing on various vitamins Food Flavours: classification, sources and application in food processing	
Word count (2021-25):127; Word count (2022-26): 183	

Lab/ Practical details:

(36 Hours)

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. Effect of pH, temperature, and substrate concentration on the enzyme activity.
2. Determination of rapidly digestible starch, slow digestible starch and resistant starch in starch of cereals and pulses.
3. Estimation of ash/minerals content in different foods (cereals, pulses, oilseed cake, dry milk, etc.,)
4. Thermal inactivation time evaluation for enzymes in fruits and vegetables.
5. Iodine value of lipids and fats.
6. Peroxide value of lipids and fats.
7. Carotenoids w.r.t pigments determination.

8. Degree of non-enzymatic browning by extraction methods.

Course Learning Outcomes

- ▶ Understand the basic role of nucleic acids and their synthesis.
- ▶ To gain knowledge about nutraceutical, functional foods, additives and antinutritional factors
- ▶ Understand the basics of protein synthesis and enzyme kinetics.
- ▶ Perceive basic knowledge about food pigments, minerals and vitamins.

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
Wong, Dominic W. S.	Food Enzymes: Structure and Mechanism	New York: Springer,	2011	9781441947222 , 1441947221	406

Environmental Studies-2

L	T	P/ S	SW/FW	TOTAL CREDIT UNITS
2	0	0	0	2

Course Contents/syllabus:

Environmental Studies-2	Teaching Hrs
Unit-1- Environmental Pollution	9 h
<p><i>Environmental Pollution:</i> types, Cause, effects and controls –Air, water, soil, chemical and noise pollution. Nuclear hazard and human health risk Solid waste Management-control measures of urban and industrial waste. Pollution case studies.</p>	
Unit-2- Environmental Policies and practices	9 h
<p><i>Environmental Policies and practices:</i> Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment laws: Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act, international agreements: Montreal and Kyoto protocols and convention on biological diversity(CBD), The Chemical Weapons Convention (CWC). Natural reserves, tribal population and rights and Human-wildlife conflict in Indian context.</p>	
Unit-3- Human communities and the Environment	9 h
<p>Impacts on environment, human health and welfare. Carbon foot-print. Resettlements and rehabilitation of project affected persons, case studies. Disaster management: floods, earthquake, cyclone and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).</p>	
Unit-4- Field work	9 h
<ul style="list-style-type: none"> • Visit to an area to document environmental assets: river/forest/flora/fauna, etc. • Visit to local polluted Site-Urban/Rural/Industrial/Agricultural • Study of common plants, insects, birds and basic principles of identification. • Study of simple ecosystems-pond, river, Delhi Ridge, etc. 	

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

- Understanding the types of pollution and their impact on environment and human health.
- Understand the environmental concerns and their impact on humans and agriculture.
- Able to analyse the impacts of natural and manmade disaster on human population and settlements.
- Sensitization about the environmental issues and concerns leading to proactive actions to improve the environmental conditions in our daily life.

- Able to imbibe practical approach and solution to solve environmental concerns.

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	--
William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo	Environmental Science: A global concern,	McGraw-Hill	2021	9781260363821	--
Gurjar B. R., Molina L.T., Ojha C.S.P. (Eds.)	Air Pollution: Health and Environmental Impacts	CRC	2010	9781439809624	--
Elaine M.A. and Bugyi G.(Eds.)	Impact of Water Pollution on Human Health and Environmental Sustainability (Practice, Progress, and Proficiency in Sustainability)	Idea Group, U.S	2016	978-1466695597	--
Bryant E.	Natural Hazards, 5th Edition	Cambridge University Press	2004	978-0521537438	--
Keith Smith	Environmental Hazards Assessing Risk and Reducing Disaster	Oxford University Press	2013	978-0415681063	--

German Grammar

Course Contents/syllabus:

L	T	P/S	SW/FW	Total Credit Units
1	0	0	0	1

Course Learning Outcomes: After completing these modules, the students will be capable

German Grammar	Total Teaching Hrs
Module I: Time (Uhrzeit); People and the World: Land, Nationalität und Sprache	4 h
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.	
Module II: Irregular verbs (unregelmässige Verben)	5 h
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	
Module III: Accusative case: articles and pronouns (Akkusativ Kasus: Artikel und Pronomen)	4 h
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	
Module IV: Accusative case: possessive pronouns (Akkusativ Kasus: Possessivpronomen) Family and Relationship	5 h
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	

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 irregular verbs they have learnt during the session. They will also have an idea of German culture by studying about various 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

Author	Title	Publisher	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	9788183072120	248

French Grammar

Course Contents/syllabus:

L	T	P/S	SW/FW	Total Credit Units
1	0	0	0	1

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

French Grammar	Teaching Hrs
Unit-I : My family and my house	4 h
Descriptors/Topics: Talk about your family members, Usage of possessive adjectives, Describe your house/apartment, Prepositions of location, Negation	
Unit-II- Lifestyle	5 h
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	4 h
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	5 h
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	

in a simple way on 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 each context

Text / Reference Books:

Author	Title	Publisher	Year of Publication	ISBN No
Christine Andant, Catherine Metton, Annabelle Nachon, Fabienne Nugue,	A Propos - A1, Livre de l'élève et Cahier d'exercices.	Langers International Pvt. Ltd.	2010	978- 9380809069
Collins Dictionaries	Easy Learning French Complete Grammar, Verbs and Vocabulary	Collins	2016	978- 0008141721

Nikita Desai, Samapita Dey Sarkar	Apprenons La Grammaire Ensemble - French	Langers International Pvt. Ltd.	2017	978- 8193002681
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Punjabi Language and Literature-2

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

Punjabi Language and Literature-2 Subject Code- INL 104	Teaching Hours
Unit I:	4 h
ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਅਧਿਐਨ (ਕਥਾ ਕਹਾਣੀ) ਕਹਾਣੀ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸਾਰ, ਪਾਤਰ-ਚਿਤਰਨ ਕਹਾਣੀਕਾਰ ਦੇ ਜੀਵਨ ਅਤੇ ਰਚਨਾ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ	
Unit II:	4 h
ਦਫ਼ਤਰੀ ਚਿੱਠੀ-ਪੱਤਰ ਰਚਨਾ ਚਿੱਠੀ-ਪੱਤਰ ਲੇਖਣ ਕਲਾ, ਮਹੱਤਤਾ ਅਤੇ ਕਿਸਮਾਂ ਦਫ਼ਤਰੀ ਚਿੱਠੀ-ਪੱਤਰ ਰਚਨਾ ਦੇ ਜ਼ਰੂਰੀ ਅੰਗ ਅਤੇ ਵੱਖ-ਵੱਖ ਵਿਸ਼ਿਆਂ ਅਨੁਸਾਰ ਵਿਹਾਰਕ ਅਭਿਆਸ	
Unit III:	5 h
ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ 1. ਪੰਜਾਬੀ ਅਰਥ ਬੋਧ ਅਰਥਾਂ ਦੇ ਆਧਾਰ ਦੇ ਸ਼ਬਦਾਂ ਦੀਆਂ ਕਿਸਮਾਂ ਅਤੇ ਉਦਾਹਰਨਾਂ, ਸਮਾਨਰਥਕ ਸ਼ਬਦ, ਬਹੁਅਰਥਕ ਸ਼ਬਦ, ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ, ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੇ ਸਥਾਨ ਤੇ ਇੱਕ ਸ਼ਬਦ ਮੁਹਾਵਰੇ, ਅਖਾਣ : ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਉਦਾਹਰਨਾਂ 2. ਪੰਜਾਬੀ ਵਾਕ ਬੋਧ ਵਾਕ ਪ੍ਰੀਭਾਸ਼ਾ, ਵਾਕ ਦੇ ਤੱਤ, ਪੰਜਾਬੀ ਵਾਕ ਤਰਤੀਬ ਵਾਕ ਵਰਗੀਕਰਨ: ਕਾਰਜ ਦੇ ਆਧਾਰ ਤੇ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ, ਬਣਤਰ ਦੇ ਆਧਾਰ ਤੇ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ	
Unit IV:	5 h
ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ 1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਤੇ ਗੁਰਮੁਖੀ ਲਿੱਪੀ 2. ਭਾਸ਼ਾ, ਉਪਭਾਸ਼ਾ, ਟਕਸਾਲੀ ਭਾਸ਼ਾ ਅਤੇ ਪੰਜਾਬੀ ਦੀਆਂ ਉਪਭਾਸ਼ਾਵਾਂ	

Course Learning Outcomes:

1. Understand modern Punjabi Stories.
2. Interpret the importance of letter writing
3. Analyze the Punjabi language structure and grammar.
4. Examine the impact and importance of Punjabi dialects and Gurmukhi script on Punjabi language.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
ਡਾ. ਧਨਵੰਤ ਕੌਰ (ਸੰਪਾ.),	ਕਥਾ ਕਹਾਣੀ	ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਚੰਡੀਗੜ੍ਹ	2009	-	-

ਸੁਰਿੰਦਰ ਸਿੰਘ ਖਹਿਰਾ (ਸੰਪਾ.),	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਆਕਰਨ ਅਤੇ ਬਣਤਰ	ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਪਟਿਆਲਾ	2015	-	-
ਡਾ. ਹਰਕੀਰਤ ਸਿੰਘ,	ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਅਤੇ ਲੇਖ ਰਚਨਾ	ਪੰਜਾਬ ਸਟੇਟ ਯੂਨੀਵਰਸਿਟੀ ਟੈਕਸਟ ਬੁੱਕ ਬੋਰਡ, ਚੰਡੀਗੜ੍ਹ	1999	-	-
ਡਾ. ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼ ਸਿੰਘ	ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਅਤੇ ਲੇਖ ਰਚਨਾ	ਮਦਾਨ ਪਬਲੀਕੇਸ਼ਨਜ਼, ਪਟਿਆਲਾ	2002	-	-
ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ	ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ	ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਪੰਜਾਬੀ ਭਵਨ, ਲੁਧਿਆਣਾ	2012	-	-
ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਸ਼੍ਰੇਣੀ ਅਤੇ ਸਰੂਪ	, ਵਾਰਿਸ ਸ਼ਾਹ ਫ਼ਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ	2012	-	-
ਦੁਨੀ ਚੰਦ੍ਰ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਣ	, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਚੰਡੀਗੜ੍ਹ	1995	-	-
ਜੋਗਿੰਦਰ ਸਿੰਘ ਪੁਆਰ ਅਤੇ ਹੋਰ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਨ (ਭਾਗ 1,2,3),	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	2003	-	-
ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	2010	--	-
ਅਗਨੀਹੋਤਰੀ, ਵੇਦ	ਪਰਿਚਾਇਕ ਭਾਸ਼ਾ ਵਿਗਿਆਨ	ਦੀਪਕ ਪਬਲਿਸ਼ਰਜ਼ ਜਲੰਧਰ	1981	-	-

History and Culture of Punjab

L	T	P/S	SW/FW	Total Credit Units
1	0	0	0	1

Course Contents/syllabus:

History and Culture of Punjab	Total Teaching Hrs
Unit I	5 h
The Mauryan Empire: Social, economic, and religious life Buddhism and Jainism: Impact on Punjab with special reference to 4th Buddhist Council. The Kushans: Impact of Kanishka's rule on Punjab	
Unit II	4 h
Gandhara School of Art: Salient features. The Guptas: Cultural and scientific developments. Position of Women: Under the Mauryas, the Guptas and the Vardhanas.	
Unit III	5 h
Depiction of Punjab in the accounts of Chinese travellers: Fahien and Huen Tsang: Main developments in literature. Education: Significant developments; Taxila	
Unit IV	4 h
Society and Culture on the eve of the Turkish invasion of Punjab. Punjab in the Kitab-ul-Hind of Alberuni.	

Course Learning Outcomes:

- Understand the history of various cultures, religions in Punjab.
- Interpret the importance of Gandhara School of Art, developments under Guptas rule and position of women.
- Compare the depiction of Punjab in the accounts of Chinese travelers.
- Examine the impact of various invasions on socio-cultural life of Punjab.

Text / Reference Books:

1. Joshi, L.M (ed.): **History and Culture of the Punjab, Part-I**, Publication Bureau, Punjabi University, Patiala, 1989 (3rd ed.)
2. Joshi, L.M and Fauja Singh: **History and Culture of the Punjab, Vol. I**, Punjabi University, Singh(eds), Patiala, 1977
3. Prakash, **Buddha: Glimpses of Ancient Punjab**, Punjabi University, Patiala, 1983
4. Thapar, Romila: **A History of India**, Vol. I, Penguin Books, 1966
5. Basham, A.L: **The Wonder That was India**, Rupa Books, Calcutta (18th rep.), 1992
6. Sharma, B.N: **Life in Northern India**, Munshi Ram Manohar Lal, Delhi, 1966

Statistics for Biosciences

L	T	P	TOTAL CREDIT UNITS
2	0	0	2

Course Contents/syllabus:

Statistics for Biosciences	Teaching Hours
Unit I:	9 h
Data collection and graphical presentation, Descriptive Statistics: Measures of central tendency-Arithmetic, geometric and harmonic mean, median, and mode.	
Unit II:	9 h
Measures of dispersion, Skewness and Kurtosis, Correlation, and regression	
Unit III:	9 h
Definitions of Probability, Conditional Probability, Bayes' theorem, random variables: discrete and continuous, density and mass functions.	
Unit IV:	9 h
Expected values and moment generating functions, Discrete distribution: Uniform, Bernoulli, Binomial, Poisson, Continuous distributions: Uniform and Normal distribution	

Course Learning Outcomes: On the successful completion of this course,

- Students will understand the concept of data collection, representation, and measures of central tendency
- Students will be able to apply the concept of dispersion, skewness, correlation, and regression of the given data
- Students will be having knowledge of probability and random variables.
- Students will be able to apply the concepts of probability and random variables to different distributions

Text / Reference Books:

Author	Title	Publisher	Year of publicatio n	ISBN
Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye	Probability and Statistics for Engineers and Scientists	Pearson; 9th edition	2010	978-0321629111
G Shanker Rao	Probability and Statistics for Science and Engineering	Universities Press	2011	9788173717444

SC Gupta, VK Kapoor	Fundamentals of Mathematical Statistics	Sultan Chand & Sons Private Limited	2000	9788180545283
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Semester 3

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				3rd Semester					
S. No.	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Food Microbiology-I	Core Course	4	0	2	0	0	6
2		Technology Of Cereal Pulses and Oilseeds - II	Core Course	4	0	2	0	0	6
3		Technology of Egg, Poultry, Meat and Sea Food	Core Course	4	0	2	0	0	6
4		Sensory Evaluation of Food	Allied course	3	0	1	0	0	4
5		Programming with C	Skill Enhancement Course	1	0	1	0	0	2
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.

Food Microbiology – I

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Food Microbiology – I	Teaching Hrs
Unit I: Introduction to Food Microbiology	18 h
History and development in food microbiology – Spontaneous generation Vs biogenesis theory, contributions of Antonie van Leewenhoek, Loius Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Alexander Fleming, Theodore Schwann, Charles Chamberland, Hans Christian Gram, Eile Metchnikoff, Nicholas Appert, Barry Marshall and Robin Warren. Definition and scope of food microbiology. Inter-relationship of microbiology with other sciences.	
Unit II: Instrumentation in microbiology	18 h
Instrumentation in microbiology - Construction and working principles of autoclave, hot air oven, pH meter, laminar air flow, incubator, bacterial colony counter, spectrophotometer and membrane filter unit. Sterilization - Physical methods - heat, irradiation, filtration, solarization, ultrasonic vibration. Chemical methods - alcohol, aldehydes, dyes, halogens, phenols, metallic salts, surface active agents, gases	
Unit III: Diversity and Classification of Food Microbes	18 h
Bacteria - classification according to Bergey's manual up to levels of section, ultrastructure, reproduction - asexual and sexual methods, importance of bacteria in food. Viruses - structure and classification - plant, animal, bacterial and cyanophycean viruses, life cycle in virus - lytic and lysogenic cycle. Fungi- outlines of classification of yeast and molds.	
Unit IV: Microbial Growth and Reproduction	18 h
Culture media used in the isolation and culturing of food microorganisms. The common nutrient requirement for bacteria - macro and micronutrients. Life cycles and reproduction; bacteria, yeast and molds. - asexual and sexual modes, spore formation in food microbes.	
Word Count (2022-2026): 232; Word Count (2023-2027): 239	

Lab/ Practical details:

(72 Hours total)

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. Introduction –Good laboratory Practices. Study of apparatus used in microbiology lab.
2. Study of compound microscope.
3. Cleaning and sterilization of glassware.
4. Preparation and sterilization of culture media-Nutrient agar, Potato Dextrose Agar
5. Inoculation and subculturing of micro-organisms –point inoculation, streak inoculation, spread plate method, pour plate method and swab method.
6. Preparation of slant, stab and plates using nutrient agar
7. Morphological study of bacteria and fungi using permanent slides
8. Simple staining

9. Gram staining

10. Negative staining

Course Learning Outcomes

- ▶ Understand the history, development and scope of food microbiology and its relationship to other sciences.
- ▶ Understand the techniques and instrumentation used in food microbiology
- ▶ Demonstrate classification and diversity of food microbes
- ▶ Perceive knowledge of microbial growth and reproduction in food microbes.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Frazier WC, Westoff DC	Food Microbiology 4th Ed.	Tata Mc Graw Hill Publ. Co. Ltd.	2014	9781259062513	492
Jay J M	Modern Food microbiology, 3rd Ed.,	Van No Strand Reinhold Co. Inc.	2005	9780387231808	790
Michael J Pelczar; Eddie C S Chan; Noel R Krieg	Microbiology,	McGraw Hill Book Co., New York	2010	9780074623206	918

Technology Of Cereal Pulses and Oilseeds - II

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Technology Of Cereal Pulses and Oilseeds - II	Teaching Hrs
UNIT I: Corn Processing Technology	18 h
structure of grain and proximate composition, corn types, Quality evaluation, Dry and Wet milling of corn. Functional properties of corn starch. Products of wet milling, corn starch–evaluation method, properties modification, Syrups, germ oil and gluten. By–products of corn milling and their utilization. Alkaline cooked products: processing of Tortillas, Modern method of Alkaline cooked products, preparation of Nixtamalized corn flours, processing of cornflakes, tortillas chips, extruded snacks, corn germ oil– composition, processing and utilization.	
UNIT II: Oats Processing Technology	18 h
Production and trade in the world, Structure of oat grains, proximate composition, chemistry, and technology. Legumes: Production, trade, varieties and structure, chemical composition, processing and cooking methods, utilization of legumes. Criteria of quality evaluation of pulses.	
UNIT III: Legumes in Human Nutrition	18 h
Nutrient composition of raw, cooked, canned and sprouted legumes. Anti-nutritional factors in legumes and their elimination. Technology of legume protein flour, Protein isolates and concentrates: Preparation uses nutritional value, their physico chemical and functional properties. Functional properties of starch and protein from pulses.	
UNIT IV: Processing of soybean products and Oilseeds	18 h
Technology of product of soya milk, tofu, soy protein concentrates and isolates. Oilseeds – Production, trade, composition, oil extraction with expellers, solvent extraction processes, purification of crude oil and hydrogenation, interesterification and refining processes for oil.	

Lab/ Practical details

(72 Hours)

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 Practical's:

1. Evaluation of corn: physico–chemical properties, dry and wet milling of corn, corn-based product, evaluation of corn starch,
2. Evaluation of oat and oat products,
3. Preparation of soya milk/tofu.
4. Experimental expeller processing and solvent extraction of oil seeds
5. Quality evaluation of oil extracted from corn germ
6. Experimental Milling of Legumes
7. Separation and evaluation of starch and protein from different legumes
8. Cooking quality, textural evaluation and physico–chemical testing of legumes.
9. Preparation of edible flours, protein concentrates and isolates
- 10 Evaluation starch characteristics of pulses
11. Determination of antioxidant activity in pulses
12. Determination of total phenolics content in pulses

13. Visit to Cereal/ Legume and Oil seeds processing plants.

Course Learning Outcomes

- Learning of the processing of cereals and pulses
- Gaining knowledge about the methods of the determination of the quality of raw, intermediate, and processed food for end-uses.
- Understanding of the oil processing and preservation
- Know-how about making wines, beer, distilled spirit and alcoholic beverages from cereals.

Text / Reference Books:					
Author	Title	Publisher	Year of publication	ISBN	Pages
B. Tiwari and N. Singh	Pulses Chemistry and Technology	Cambridge, UK: RSC Pub	2012	9781849733311	310
Fereidoon Shahidi; Alton Edward Bailey	Bailey's industrial oil and fat products	Wiley-Interscience,	2005	9780471384601	3616

Technology of Egg, Poultry, Meat and Sea Food

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Technology of Egg, Poultry, Meat and Sea Food	Teaching Hrs
UNIT I: Egg Industry and Egg Production Practices	18 h
The egg industry, its techniques of working, general management of poultry farm. Refrigeration and freezing, egg powder manufacture, egg coatings. Quality identification of shell eggs Factors affecting egg quality and measures of egg quality	
UNIT II: Introduction and meat quality	18 h
Livestock and poultry population in India, Development of meat and poultry industry in India and its need in nation's economy, Terminology used for animals and birds based on age, sex, cuts, use. Effects of feed breed and stress on production of meat animals and their quality. Meat Quality -color, flavor, texture, Water-Holding Capacity (WHC), Emulsification capacity of meat	
UNIT III: Slaughter process and By-products	18 h
Layout of abattoirs, Slaughter, Antemortem examination of meat animals, slaughter of buffalo, sheep/goat, poultry, pig. A Generic HACCP model for poultry slaughter, post-mortem examination of meat, Grading, Post-mortem changes of meat. Importance of by-products utilization, classification and uses of by-products, Manufacture of Natural casings Methods of the preservation of meat and meat products.	
UNIT IV: Fish Curing, Smoking and Canning	18 h
Drying and salting of fish, water activity and shelf-life, salting process, salting methods (brining, pickling, kench curing, gaspe curing), types of salts, dried and salted fish products- pindang, fishwood, dried shrimp. Preservation by smoking, smoke production, smoke components, quality, safety and nutritive value of Smoked fish, processing and equipment, pre-smoking processes, smoking process control. Traditional chimney kiln, modern mechanical fish smoking kiln, examples of smoked and dried products. Principles of canning, classification based on pH groupings, effect of heat processing on fish, storage of canned fish, pre-process operations, post process operations, cannery operations for specific canned products. (Tuna, Mackerel, Sardine).	

Lab/ Practical details:

(72 Hours)

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

1. Estimation of moisture content of meat
2. Estimation of protein content of meat
3. Cut out analysis of canned meats/retort pouches
4. Analysis of frozen meat/meat emulsion products
5. To study shelf-life of eggs by different methods of preservation
6. Evaluation of eggs for quality parameters (market eggs branded eggs)

7. To perform freezing of yolk/albumen
8. Meat/Egg product formulation
9. Quality evaluation of fish/prawn.
10. Subjective evaluation of Fresh Fish.
11. Cut out examination of canned fish (Sardine, Mackerel, Tuna)
12. Fish product formulation.

Course Learning Outcomes

- Gaining knowledge about the status of the livestock and poultry industry, production, future demands.
- Understanding about the meat quality, flavour and texture
- Skilled for the preservation of food freezing, drying and smoking
- Gaining in-depth knowledge of fish processing and preservation technologies

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Lawrie, R. A.	Lawrie's Meat Science. 5th ed.	England: Woodhead Publishing Ltd.	1998	9781855733954	336
Parkhurst, C., & Mountney, G. J.	Poultry Meat and Egg Production.	New Delhi: CBS Publishers.	1997	9789401170550	308
Pearson, A. M., & Gillett, T. A.	Processed Meats. 3rd ed.	Maryland : Aspen Publishers	2020	1176526949	448
Shai, Barbut.	Poultry Products Processing.	CRC Press.	2005	9781587160608	548
Stadelman, W. J., Newkirk, D., & Newby, L.	Egg science and technology. 4th ed.	New Delhi: CBS Publication.	2002	9781560228554	591

Sensory Evaluation of Food

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

Course Contents/syllabus:

Sensory Evaluation of Food	Teaching Hrs
UNIT I: Colour Analysis of Foods	18 h
Introduction and importance of colour. Dimensions and attributes of colour, appearance factors, gloss etc. Perception of colour. Colour abnormalities Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, Tintometer Measurement of colour; Munsell colour system, CIE colour system, Hunter colour system, spectrophotometry, colorimetry, advances in colour measurement.	
UNIT II: Olfaction	18 h
Odour Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Odour classification, chemical specificity of odour. Odour measurement using different techniques –historical perspective and emphasis on recent techniques like e-nose. Merits and demerits of each method. Olfactory abnormalities	
UNIT III: Introduction and importance of taste	18 h
Taste Introduction and importance of taste Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands Mechanism of taste perception Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami Factors affecting taste quality, reaction time, taste modification, absolute and recognition Threshold Taste abnormalities Taste measurement	
UNIT IV: Texture analysis of Foods	18 h
Introduction, definition and importance of texture, Phases of oral processing Texture perception, receptors involved in texture perception, Texture classification Texture measurement – basic rheological models, forces involved in texture measurement. Some objective methods of texture evaluation of foods- spreadimeter, compressimeter etc. Assessment of Texture of different food Products - bread, biscuits/ cookies, dairy - butter, cheese rheology, fruits and vegetables- peas, apples	

Lab/ Practical details:

(36

Hours)

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.

1. Training of sensory panel.
2. To perform recognition tests for basic tastes.

3. Discriminative and Descriptive Tests: Simple and directional, Difference tests, Ranking and Rating Tests.
4. Sensitivity Tests: Threshold, /Dilution for basic tastes
5. To perform Affective Tests (Preference and Acceptance Tests) on Hedonic Scale (verbal, facial).
6. Colour measurement using Hunter Colour Lab.
7. Texture Analysis of selected fruits (mature and immature), vegetables (tomato), milk products, Cereal and pulse products.

Course Learning Outcomes

- Understanding the chemistry of taste, methods of analysis and instruments
- Learning about the chemistry of flavour and its analysis methods
- Know-how about colour, its determination and role in food sensory
- Learning about the texture analysis of food and its role in the determination of acceptability of food by consumer

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Meilgard	Sensory Evaluation Techniques, 3rd ed.	CRC Press LLC.	1999	9780849338397	448
Rao, E. S.	Food Quality Evaluation,	Variety Books.	2013		
Harry, T., Lawless, Barbara. & P. Klien	Sensory science theory and applications in Food	Marcel Dekker, Network.	1991	978938115621	441

Programming with C

L	T	P	SW/FW	TOTAL CREDIT UNITS
1	0	1	0	2

Course Contents/syllabus:

Programming with C	Teaching Hours
Unit I: Introduction of Programming Languages	5 h
Introduction: Types of Languages, Evolution of 'C' Language, Structure of a 'C' Program, C' Program development life cycle, Executing and Debugging a 'C' Program. 'C' Tokens: Keywords and Identifiers, Operators, Constants, Variables, Data Types, Precedence of Operators, Scope and Lifetime of Variables.	
Unit II: Control Statement and Looping	4 h
Control Statements: Decision Making using if statement, Types of if ...else block, Switch case Block, Arithmetic Expressions, Evaluation of Expressions, GOTO statement Looping: Concept of Loop, For loop, While loop, Do while loop, Jumping in Loop, break and continue statement.	
Unit III: Arrays and Strings	4 h
Arrays and Strings: Introduction to array, Processing Array Contents, 2D arrays, Array with three or more dimensions. String, string concatenation, Comparing strings, String handling Functions.	
Unit IV: Functions, Structure and Unions	5 h
Function: Concept of Function, User defined Function, System Defined Function, Function Calling, Types of parameters passing in function, return type in Function. Structure & Union: Need of Structure, Implementing Structure Variable, Arrays of Structure, Structure within Structure, Introduction of Unions, Difference between Structure and Unions.	

Lab/ Practical details, if applicable:

Objective: The aim of this section of Lab is to teach experiments of C programming pertaining to the units being taught in the theory paper specifically related to procedural programming, strings, structures and unions.

1. Write a Program to read radius value from the keyboard and calculate the area of circle and print the result in both floating and exponential notation.
2. Write a Program to convert temperature. (Fahrenheit –Centigrade and vice-versa)
3. Write a program for computing the volume of sphere, cone and cylinder assume that dimensions are integer's use type casting where ever necessary.
4. Write a Program to read marks of a student in six subjects and print whether pass or fail (using if-else).
5. Write a Program to calculate roots of quadratic equation (using if-else).
6. Write a Program to calculate electricity bill. Read starting and ending meter reading. The charges are as follows.

No. of Units Consumed	Rate in(Rs)
1-100	1.50 per unit
101-300	2.00 per unit for excess of 100 units
301-500	2.50 per unit for excess of 300 units
501-above	3.25 per unit for excess of 500 units

Do the Following Programs Using for, while, do-while loops.

7. Write a program to calculate sum of individual digits of a given number.
8. Write a program to check whether given number is palindrome or not.
9. Write a program to check whether a given number is a Fibonacci number or not.
10. Write a program to read 2 numbers x and n then compute the sum of the Geometric Progression. $1+x+x^2+x^3+ \dots +x^n$
11. Write a program to print the following formats.

```

1           *
1 2        * * *
1 2 3      * * * * *
1 2 3 4    * * * * * * *
    
```

12. Write a program to perform matrix addition, matrix subtraction and transpose of a matrix.
13. Write a program to verify the given string is palindrome or not (without built-in functions, with using built-in functions).
14. Write a program to swap two numbers using a) Call By Value B) Call By Reference.
15. Write a program to create structure for an account holder in a bank with following Fields: name, account number, address, balance and display the details of five account holders.

Course Learning Outcomes: After studying this course students will be able:

1. To understand the fundamentals and tokens of C programming.
2. To develop skills to implement decision making through control structures in C.
3. To Analyze the working and implementation of array in memory.
4. To Optimize the code with the help of functions and structures.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN
Jeri R. Hanly, Elliot B. Koffman	Problem Solving and Program Design in C	Pearson	2015	978- 0134014890
Pradip Dey, Manas Ghosh	Programming In C	Oxford University Press	2018	978- 0199491476
E Balagurusamy	Programming in ANSI C	McGraw Hill Education	2019	978- 9351343202
Yashwant Kanetkar	Let Us C	BPB Publications	2020	978- 9389845686

Semester 4

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				4th Semester					
S. No.	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Food Microbiology-II	Core Course	4	0	2	0	0	6
2		Food Engineering	Core Course	4	2	0	0	0	6
3		Food Quality Assurance	Core Course	4	0	2	0	0	6
4		Food Quality Management	Allied course	4	0	0	0	0	4
5		Food Product Development	SEC	2	0	0	0	0	2
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.

Food Microbiology – II

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Food Microbiology - II	Teaching Hrs
Unit I: General principles underlying spoilage of food	18 h
Fitness and unfitness of food for consumption; Causes for spoilage. Microbiology of air borne diseases - bacterial and fungal.	
Unit II: Microbiology of water	18 h
Sources, bacteriological examinations, total count, test for <i>E. coli</i> . Purification of water – filtration, sedimentation, disinfection. Water borne diseases - bacterial, viral, protozoan. Microbiology of sewage and sewage disposal.	
Unit III: Microorganisms organisms causing spoilage of food Products	18 h
Factors affecting kinds and numbers of microorganisms in food. Factors affecting the growth of microorganisms in food. Contamination and kinds of organisms causing spoilage of fruits and vegetables, meat, poultry, fish, eggs, milk and milk products, fats and oils, bottled beverages, spices, and condiments.	
Unit IV: Food poisoning	18 h
Food poisoning - Staphylococcal poisoning, Streptococcal poisoning, botulism, salmonellas, Shigellosis. Food borne infections - Clostridium perfringens, Vibrio, EPEC, Bacillus cereus, Campylobacter, Listeria, yersiniosis.	
Word count (2022-26): 154; Word count (2023-27): 213.	

Lab/ Practical details: (72 Hours)

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) Estimation of lactic acid in milk
- 2) Quality tests for milk-Methylene Blue Reduction Test, Resazurin test.
- 3) Isolation and morphological identification of micro-organisms from spoiled food samples
- 4) Sampling of water- membrane filtration technique and CC agar
- 5) Standard Plate Count for raw and pasteurized milk samples.
- 6) Coliform count in water using MPN method.
- 7) Sampling of food handlers.

Course Learning Outcomes

- ▶ Understand the principles of various methods used in the prevention and control of microorganisms in foods
- ▶ Understanding of interactions between microorganisms and the food environment, and factors influencing their growth and survival

- ▶ Understanding the role of water as a carrier of microorganisms and methods of treating the waste sewage water.
- ▶ Understand the spoilage patterns of different foods and enumeration of spoilage-causing microorganisms.
- ▶ Understand the disease-causing potential of food-pathogens and related pathophysiology in human systems.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
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
Pelezer ML, Reid RD	Microbiology	McGraw Hill Book Co., New	2010	9780074623206	918
York Brown A, Smith H	Benson's Microbiological applications	McGraw Hill Publ.	2005	9780072823974	413
K R Aneja	Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology, 5 th Edition	New Age International Publishers, London, New Delhi, Nairobi	2018	978-93-86418-30-2	580
Lansing M. Prescott John P. Harley Donald A. Klein	Microbiology, 5 th Edition	The McGraw–Hill Companies,	2002	978-0697168887	1147

Food Engineering

L	T	P/S	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Food Engineering	Teaching Hrs
UNIT I: Introduction to Food Engineering	18 h
Concept of Unit operation, Units and dimensions, Unit conversions, dimensional analysis Mass and Energy Balance, Related numerical Design of food plant and grinding & mixing unit operation Important considerations for designing of food plants, Types of layouts, Design and layout of storage godown, Principle and equipment used in grinding in food industry, Principle and equipment used in mixing in food industry	
UNIT II: Fluid Flow in food Processing	18 h
Liquid Transport systems, Newton's Law of Viscosity, Principle of Capillary tube and rotational viscometer, Properties of Non-Newtonian fluids, Flow characteristics, Reynolds Number, Bernoulli's Equation Concept of Flow Measurement devices, Related basic numerical	
UNIT III: Refrigeration and Freezing	18 h
Concept and selection of a refrigerant, Description of a Refrigeration cycle, Pressure Enthalpy charts and Tables, Mathematical expressions useful in analysis of vapour compression refrigeration cycle, Numerical on VCR system using R -134 a, R-717 including super heating and sub cooling, freezing time calculation using Plank equation, Frozen food storage, Related basic numerical	
UNIT IV: Heat and Mass Transfer	18 h
Systems for heating and cooling food products Thermal Properties of Food, Modes of heat transfer Psychometrics, Steam, Evaporation and Dehydration Properties of dry air, water vapour, air vapour mixture, Psychrometric Chart and its application, Generation of steam, Construction and functions of fire tube and water tube boilers, Thermodynamics of Phase change, Steam tables, Boiling point elevation Types of evaporators, Design of single effect evaporators, Basic Drying Process Moisture content on wet basis and dry basis, numerical, Dehydration systems, Dehydration system Design, Numerical Application of steady state heat transfer- estimation of conductive heat transfer coefficient, convective heat transfer coefficient, overall heat transfer coefficient and, design of tubular heat exchanger, related basic numerical Fick's Law of Diffusion Membrane separation systems-Electrodialysis system, Reverse Osmosis, Ultra filtration, Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices,	

List of Experiments -with basic instructions

1. Concept of Unit operation and related numerical
2. Fluid Flow in food Processing and related basic numerical
3. Refrigeration and freezing and related basic numerical
4. Heat and mass transfer and related basic numerical

Course Learning Outcomes

- Knowledge of the fundamentals of food engineering.

- Capability to design food plants for storage, processing and preservations.
- Understood about principle of food flow dynamics of fluid under different conditions.
- Learn about refrigerants, and their applications in different freezing systems

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Earle, R.L.	Unit Operations in Food Processing, 2 nd 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

- Gain in depth knowledge about psychometrics, steam, evaporation and dehydration and its kinetics through numerical.

Food Quality Management

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

Course Contents/syllabus:

Food Quality Management	Teaching Hrs
UNIT I: Food Quality Management	18 h
<p>Introduction to food quality: Definition, quality concepts, quality, quality perception, and quality attributes.</p> <p>Concepts of quality management-Objectives, importance and functions, quality control through the concept of Total quality management, process approach, good management practices, principles of quality management systems,</p> <p>Quality and dynamics in the Agri- food production chain, Techno-managerial approach, food quality relationship and food quality management functions</p>	
UNIT II: Contamination in Food Chain	18 h
<p>Physical, chemical contaminants- heavy metals, pesticide residues, agrochemicals, antibiotics and veterinary Drug residues, environmental pollutants, radionuclides, solvent residues, NOTS (Naturally Occurring Toxic Substances)</p> <p>Food Processing and contaminants– nitrosamines, acrylamide, dioxins, furans, persistent organic pollutants, polymers, PAH (Polycyclic Aromatic Hydrocarbons) in smoked foods, Emerging concerns in food- Microplastics, Bisphenol A, Endocrine Disruptors, Food Allergens, Antimicrobial Resistance (AMR)</p>	
UNIT III: Quality Management Tools	18 h
<p>quality systems and tools used for quality assurance including control charts, acceptance and auditing, inspections, critical control points, reliability, recall and liability, The principles and practices of food plant sanitation and waste management.</p>	
UNIT IV: Food additives and Quality Management	18 h
<p>Introduction, need of food additives in food industry. Characteristics and classification of food additives.</p> <p>Chemical, technological and toxicological aspects of following food additives:</p> <p>Antimicrobial agents: Nitrites, sulphides, sulphur di oxide, sodium chloride, hydrogen peroxide.</p> <p>Antioxidants – Mode of action, natural and synthetic antioxidants, technological aspect of antioxidants.</p> <p>Sweeteners- Introduction, importance, classification- natural and artificial, chemistry, technology and toxicology, consideration for choosing sweetening agents.</p> <p>Colors- classification- natural, artificial, and natural identical, FD & C Dyes and Lakes.</p>	

Recent advances in Food Colours- Use of plant tissue culture, polymeric colors.	
Word count (2022-26): 282; Word count (2023-27): 271	

Course Learning Outcomes

- ▶ Theoretical understanding of concept and dynamics of quality management in food systems.
- ▶ Understanding of food contaminants and emerging concerns in food chains
- ▶ Understand the role of food additives and related risk assessment during food processing.
- ▶ Understand the quality management concepts for food additives like antimicrobials, anti-oxidative and sweeteners.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Pieterneel A, Luning. & Willem, J. Marcelis.	Food Quality Management Technological and Managerial principles and practices.	Wageningen Academic Publishers,	2020	9789086863488	425
Shapton, D.A. and Shapton, N.F.	Principles and Practices for the safe processing of Foods.	Woodhead Publishing Ltd.,	2008	9781855733626	457
WHO and FAO	Food Safety Risk Analysis- a guide for national food safety authorities	World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO)	2006	978-92-5-105604-2	119
Blackburn, C.D.W. and Mc Clure, P.J.	Food borne pathogens. Hazards, risk analysis & control	Cambridge: Woodhead, 2001.	2005	9781855734548	521

Food Product Development

L	T	P	Total Credits
2	0	0	2

Course Contents/syllabus:

Food Product Development	Teaching Hours
Unit I: Introduction to food product development	9 h
Introduction to food product development and management viz. to conceive ideas, evaluation of ideas, developing ideas into products, test marketing and commercialization, quality and sensory assessment for product shelf life	
Unit II: Computer aided product development	9 h
Computer aided ingredient analysis, Computer aided formulation. Properties, roles, and development of food packaging for new food products. Principles of package design	
Unit III: Ingredient technology	9 h
Ingredient technology: Properties, roles and applications of colouring, flavouring, additives and functional ingredients in foods, Ingredient interactions	
Unit IV: Consumer trends, guidelines and recent advances	9 h
Consumer trends and their impact on new product development, nutritional labelling requirements, Food fortification in new product development,	
Word count (2022-26): 122; Word count (2022-26): 131	

Course Learning Outcomes:

- Understand fundamentals of food product development.
- Acquisition of information technology tools to analyze food ingredients and product designing.
- Perceive knowledge about role of food ingredients in overall food quality.
- Studying about consumer trends, labelling guidelines, and scope of new food products.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Moskowitz H R, Saguy I M, Strauss T eds.	An integrated approach to new product development	CRC Press, Boca Raton, FL	2018	9781138198388	479
Mc Fie H	Consumer led food product development.	CRC Press, Boca Raton, FL	2007	9781845690724	613
Fuller, G. W.	New food product development: from concept to marketplace	CRC Press, Boca Raton, FL	2011	9781439818640	472
Earle, M., Earle, R., and Anderson, A.	Food Product Development.	CRC Press.	2001.	9781855736399	392
Grap, E., Saguy,	Food Product Development:	Gaithersburg, Md. : Aspen Publishers	1999	9780442001858	441

and Graf, E.	From Concept to the Marketplace.				
Smith J, Charter E	Functional food product development.	IFT Press, Wiley- Blackwell, Indianapolis, IN	2010	978140517876 1	512

Semester 5

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				5th Semester					
S. No.	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	S W	
1	FST304	Milk and Milk Products Processing Technology	Core Course	4	0	2	0	0	6
2	FST301	Food Packaging	Core Course	4	0	2	0	0	6
3		Crop Science	Specialization Elective Courses	4	0	0	0	0	8 (Any two)
4		Confectionary Technology	Specialization Elective Courses	3	0	1	0	0	
5	FST303	Principles of Fermentation Technology	Specialization Elective Courses	4	0	0	0	0	
6	FST302	Spices and Flavour Technology	Specialization Elective Courses	4	0	0	0	0	
7		Programming in Python Lab	Skill Enhancement Course	0	0	2	0	0	2
8		Bioentrepreneurship	Skill Enhancement Course	2	0	0	0	0	2
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.

Milk and Milk Products Processing Technology

L	T	P	SW/F W	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Milk and Milk Products Processing Technology	Teaching hrs
UNIT I: Milk composition and Physical properties of milk	18 h
Milk composition, Colour, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, electrical conductivity General structure, Amphoteric nature, difference between casein and serum protein, different types of casein (acid and rennet), uses of casein, fractionation of protein.	
UNIT II: Milk fat, enzymes and Lactose	18 h
Milk fat: Composition and structure, factors affecting melting point, boiling point, solubility and Refractive Index, fat constants (saponification value, iodine value, RM value, Polenske value, peroxide value). Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring auto-oxidation, prevention, measurement of auto-oxidation Enzymes in dairy processing- Catalase, Alkaline phosphatase, lipases and Proteases, Lactose , Lactose (alpha and beta forms and their differences), Significances of lactose in dairy industry Salts in milk,	
UNIT III: Liquid milk processing	18 h
Liquid milk processing– filtration/clarification, standardization, pasteurization– (objectives, types, LTLT, HTST, UHT, equipment, advantages), Homogenization (objectives, process, advantages). Systems of collection of milk, Reception, Platform testing, Various stages of processing: Filtration, Clarification, Homogenization, Pasteurization, Description and working of clarifier, cream separator, homogenizer and plate heat exchanger Handling and maintenance of dairy plant equipments, Special milks: standardized milk Sterilized, flavored, homogenized, fortified, reconstituted, recombined, toned, double toned, vitaminized, humanized, Packaging, storage transport, distribution of liquid milk.	
UNIT IV: Market milk industry, milk plant equipments and milk products	18 h
Milk product processing: Fermented milk, Cream, Butter, ghee, butteroil, yoghurt, dahi, shrikhand, ice-cream, condensed milk, evaporated milk, milk powders- whole and skimmed milk powder, khoa, chenna, paneer, cheese (cheddar). Cheese spreads, enzyme modified cheese, Judging and grading of milk products Milk powders, whole and SMP, milk powder agglomeration, equipment used and properties and advantages HACCP in the milk plant.	

Lab/ Practical details:

(72 Hours)

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

1. To perform platform tests in milk (Acidity, COB, MBRT, specific gravity, SNF)
2. To estimate milk protein by Folin method.
3. To estimate milk fat by Gerber method.
4. Preparation of flavoured milk.
5. Pasteurization of milk.
6. To prepare casein and calculate its yield.

Course Learning Outcomes

- Know-how about principles of dairy science and the composition of milk.
- Understanding about milk processing plants, transportation, preservation, reconstitution and distribution of milk and milk products.
- Perceive knowledge of milk production
- Demonstrate HACCP application in dairy industry

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
De, Sukumar.	Outlines of Dairy Technology	Oxford: Oxford University Press.	2007	914164841	539
P. F. Fox	Dairy Chemistry & Biochemistry	Springer	2015	978-3-319-14891-5	598

Food Packaging

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

	Teaching Hrs
UNIT I: Food Packaging	18 h
Introduction to Food Packaging Definitions, status of packaging industry in India and globally Packaging functions Barcodes & RFID	
UNIT II: Food Packaging Materials	18 h
Manufacturing of paper, types of paper and corrugated fiber board (CFB). Food grade plastics, properties, methods of manufacturing (Injection molding and Blow molding) Biodegradable plastics, edible packaging Metals, Tinplate, tin free can (TFC), types of can Glass: Composition, Properties, methods of bottle making, types of closures. Regulatory Aspects of Food Packaging Environment concerns (RRRR), LCA and method of its estimation Food Packaging and Labelling Laws (FSSAI), Retort packaging Active and Intelligent packaging systems	
UNIT III: Package Designing for Foods	18 h
Factors affecting spoilage, package requirement and package designing for: Fresh horticultural produce, Animal foods, Dry and moisture sensitive foods, Frozen foods, Fats and oils, Thermally processed foods	
UNIT IV: Testing of Food Packaging	18 h
Testing Procedures for Packaging Materials- thickness, tensile properties, puncture resistance, bursting strength, seal strength, water vapor permeability, gas transmission rate (CO ₂ and O ₂ permeability), grease resistance, Compatibility and shelf-life studies Evaluation of transport worthiness of filled packages	

Lab/ Practical details:

(72 Hours)

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

1. Testing of physical/mechanical properties of food packaging material.
2. Testing of thermal shock resistance of glass.
3. Gas/Vacuum packaging of foods and shelf-life studies.
4. Determination of Water Vapor Transmission rate of Packaging Material.
5. Edible packaging of Food Samples.
6. Study of Sorption Isotherm for Food Package Design.
7. Packaged food cut-out analysis.
8. To study the operation of FFS machine.

Course Learning Outcomes

- Knowing concepts of food packaging material, technology and their suitability for packaging of different kind of food products

- Understanding about manufacturing of different kinds of packaging material such as biodegradable plastic, edible films, etc.
- Learning technological innovations in packet designing for different food items
- Learning about testing of packaging material and its relationship to the shelf life and food quality and sensory etc.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Coles, R. and Kirwan, M.	Food and Beverage Packaging Technology,	Wiley-Blackwell publication	2011	9781405189101	326
Coles, R., McDowell, D.& Kirwan, MJ.	Food Packaging Technology.	Blackwell publication	2003	9781841272214	346

Confectionary Technology

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

Course Contents/syllabus:

Confectionary Technology	Teaching Hrs
UNIT I: Introduction to Confectionary Industry	13 h
Introduction Current status and economic importance of Confectionary Industry in India. Confectionery product types and their pertinent standards & regulations.	
UNIT II: Sugars	14 h
Sugars- Types and sources Methods of preparation of sugars, jaggery, khandsari, raw and refined sugar- quality and properties. Principles of sugar cookery, crystalline and non-crystalline candies.	
UNIT III: Confectionary Products	14 h
Confectionary Products: Cake icings, hard-boiled candies, toffees, fruit drops, chocolates and other confections- ingredients, equipment's & processes, product quality parameters, faults and corrective measures. Cocoa butter, rendering and polymorphism of cocoa fat, properties of fat required for chocolate preparation	
UNIT IV: Cocoa products	13 h
Chocolate and chocolate products History of chocolate. Ingredients in chocolate; crystalline and amorphous sugar; lactose, glucose and fructose; milk and other dairy ingredients. Refining and conching of chocolate. Liquid chocolate: viscosity, effects of particle size, fat addition, emulsifier, moisture. Chocolate Tempering, Molding, Enrobing and Panning. Packaging Requirements and material used in packaging of chocolate.	

Lab/ Practical details: (36 Hours)

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

1. Estimation of Sugar solubility, acidity and sulphated ash content of sugar and jaggery
2. Determine the effect of heat on sugar solution and perform the thread and cold-water test.
3. To study the process of inversion, melting, caramelization and crystallization in sucrose.
4. To study the concept of sugar-based product formulation
5. Fondant/fudge/ brittles.
6. Candy/ toffee/ fruit drop
7. To study the tempering of fat in chocolate preparation
8. To study the effect of cocoa butter replacer in chocolates
9. Visit to confectionary plant to study equipment and processes

Course Learning Outcomes

- Understanding basic principles of sugar production industry, methods of different types of sugar productions.
- Learning science and technologies of making confectionary and related products.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Edwards, William. P.	The Science of Sugar Confectionery	The Royal society of Chemistry	2019	9781788011334	221
Lees, R. & Jackson, EB.	Sugar Confectionery and Chocolate Manufacture	Springer	1992	668135971	373
Minifie, B.W.	Chocolate, Cocoa, and Confectionery Science and Technology	Aspen Publication.	2014	9781489957474 9780834213012	904

Crop Science

Course Contents/syllabus:

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

Crop Science

Units	Teaching Hrs
UNIT I: Introduction to crops	18 h
Classification of crops, Study of the following crops with particular reference to climatic and soil requirements, their improved cultural practices with special emphasis on seed bed preparation, improved varieties, rotations, seed and seed treatment, sowing, manures and fertilizers, irrigation requirements, weed control, harvesting and marketing. Cereal crops: Paddy, Maize, Wheat	
UNIT II: Cultivation and Management of Pulses	18 h
Study of the following crops with particular reference to climatic and soil requirements, their improved cultural practices with special emphasis on seed bed preparation, improved varieties, rotations, seed and seed treatment, sowing, manures and fertilizers, irrigation requirements, weed control, harvesting and marketing. Pulses: Green gram, Black gram, Bengal gram and Soyabean. Oilseeds: Groundnut, Sunflower and Mustard.	
UNIT III: Cultivation and Management of Vegetables	18 h
Study of the following crops with particular reference to climatic and soil requirements, their improved cultural practices with special emphasis on seed bed preparation, improved varieties, rotations, seed and seed treatment, sowing, manures and fertilizers, irrigation requirements, weed control, harvesting and marketing. Vegetables: Egg plant (Brinjal), Tomato, Ladyfinger, Peas, Cauliflower, Cabbage, Carrot, Potato.	
UNIT IV: Cultivation and Management of Horticulture crops	18 h
Horticultural Crops: Study of fruits with special emphasis on selection of site and soil, their cultural practices with reference to training, pruning, propagation methods, harvesting and fruit handling of Mango, Papaya and Kinnow.	

Course learning outcomes:

- Understand basics of cereal pulses, legume, and vegetable crops
- Demonstrate seed production by different methods
- Compare fertilizer requirements for different crops
- Perceive the knowledge of vegetative propagation of different horticulture crops

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Alken C.,	Crop science	Syrawood Pub House, 2016	2016	9781682863602	285
Victor Sadras. Daniel	Crop Physiology Case	Academic Press; 1st edition	2020	978-0128191941	778

Calderini (Editor)	Histories for Major Crops	(December 24, 2020)			
Cassius, F.,	Crop Science and Technology	Larsen & Keller Educ	2017	9781635490183	245

Principles of Fermentation Technology

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

Course Contents/syllabus:

Principles of Fermentation Technology	Teaching Hrs
UNIT I: Introduction to Fermentation Process	18 h
Introduction Fermentation process, Importance of Fermented products, Isolation and maintenance of pure culture, Preparation of substrates/media, inoculums	
UNIT II: Understanding microbial growth and different nutrition media	18 h
Rate of microbial growth and death, factors affecting growth, basic nutrition, principles of production media, components of media, chemical composition of media.	
UNIT III: Microbial growth kinetics and downstream processing	18 h
Fermentation Kinetics Types of fermentation sub-merged/solid state, Batch/continuous fermentation, Fermenter design, operation, measurement, and control in fermentation, Aeration and agitation in fermentation: Oxygen requirement, sterilization of air and media. Recovery of fermentation products and conversion into marketable/storage forms	
UNIT IV: Fermented Products	18 h
Production of baker's yeast, food yeast, Single Cell Protein, Beer, Wine, Cider, Vinegar, Cheese, Lactic acid, Fermentation of milk, vegetables, cereals, Mushroom cultivation, IMFL/distilled spirits	

Course Learning Outcomes

- Understanding basic principles of food fermentation, bacterial strains, and other processes in food industry
- Perceive knowledge of fermentation kinetics
- Learning science and technologies involved in the production of different food products
- Demonstrate production of Fermented products

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

Spices and Flavour Technology

Course Contents/syllabus:

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

Spices and Flavour Technology

Units	Teaching Hrs
UNIT I: Classification & use of spices	18 h
Chemical constituents of spices. Processing of white pepper: Cultivars and varieties: quality issues, Cultivation, Handling after harvest, Chemical structure, Quality issues, Industrial processing, Functional properties, Use of pepper in food.	
UNIT II: Processing of Spices	18 h
Cryo-milling of spices, Spice oleoresins and encapsulated spices and spice emulsion. Packaging of spices and spice products.	
UNIT III: Preservation, Packaging and Quality of spices	18 h
Microbial contamination and insect infestation in spices and its control. Quality standards for processed spices and their products.	
UNIT IV: Origin, and classification of flavouring compounds	18 h
Origin Of Flavor Compounds, Classification, and application of flavouring compounds in foods: Natural Flavours, Processed Flavour, Added Flavour, Synthetic Flavour, Flavour Enhancer	

Course learning outcomes

- ▶ Define processing of various spices and condiments
- ▶ Understand the post-harvest technology for major plantation crops
- ▶ Recognize the application of different volatile oil for flavor extraction
- ▶ Perceive the knowledge of science of flavouring compounds

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Peter K.V.,	Handbook of Spices	Woodhead Publishers, UK.	2001	9780857090393	640
Pruthi, J.S.	Spices and Condiments	NBT India.	2011	9788123722436	322
Spices Board	Spices in different states: 1991 ; facts and figures	GOI, Cochin.	1991	753319943	72

Bioentrepreneurship

L	T	P	Total Credits
2	0	0	2

Course Objectives: To help students gain understanding of the basic concepts of entrepreneurship, diagnose new business opportunities, formulate business plans, and identify different institutional support available to the entrepreneurs.

Course Content/ Syllabus

	Weightage (%)	Teaching Hours
Unit I: Basic Concepts of Entrepreneurship	25	9
Introduction to Entrepreneurship: Meaning, Background, Importance, The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Factors that Influence Entrepreneurship, How to Avoid the Pitfalls, Factors Responsible for Entrepreneurship Growth; Entrepreneur Background and Characteristics; Entrepreneurial Potential in a Prospective Entrepreneur; Entrepreneurial Skills and Competencies; Types of entrepreneurs and entrepreneurship, Myths and Realities about Entrepreneurs; New Trends in Entrepreneurship Development; Economic Development through Entrepreneurship; Role of Entrepreneurship in the Economic Development of India		
Unit II: Environmental Monitoring and Importance of Business Idea	25	9
Creativity and innovation, Role of Creativity & Innovation in Entrepreneurship, Sources of New Ideas – Consumers, Existing Products and Services, Distribution Channels, Federal Government, Research and Development; Methods of Generating Ideas – Focus Groups, Brainstorming, Brainwriting, Problem Inventory Analysis; Creative Problem Solving – Brainstorming, Reverse Brainstorming, Brainwriting, Gordon Method, Checklist Method, Free Association, Forced Relationships, Collective Notebook Method, Attribute Listing Method, Big-dream Approach, Parameter Analysis, Mind Mapping, Force-Field Analysis, TRIZ, Rapid Prototyping; Innovation, Types of Innovation – Breakthrough, Technological, and Ordinary Innovation; Opportunity Recognition; Product Planning and Development Process – Idea Stage, Concept Stage, Product Development Stage, Test Marketing Stage, and Commercialization Stage; Technology Readiness Levels; Intellectual Property Rights		
Unit III: Scanning the Environment & Business Plan Development	25	9

Identifying the business opportunity: SWOT and PESTEL analysis, Viability Screening/Feasibility Analysis: Market Feasibility, Production Feasibility, Organisational Feasibility, Financial Feasibility; Business Plan Development: Introduction, Business Plan, Various Business Models – The Business Model Canvas, The Lean Canvas, Types of Business Plans, Structure of a Basic Business Plan, Creating a Business Plan – Executive Summary, General Company Description, The Opportunity or Competitive Analyses, Market Research and Industry Analysis, Strategy, The Team, Marketing Plan, Operational Plan, Financial Plan, and An Appendix		
Unit IV: Sources of Capital and Institutional Support for Entrepreneurs	25	9
Sources of Funding for Entrepreneurs: Bootstrapping, Friends and Family Members, Crowdfunding, Angel Investment, Venture Capital, Financial Institutions, Bank Loans, Trade Credit, Initial Public Offerings/Issue of Shares, Debentures; Role of Government in Promoting Entrepreneurship: Atal Innovation Mission, Biotechnology Industry Research Assistance Council, Department of Science and Technology, Digital India, Jan Dhan-Aadhaar-Mobile, Make in India, National Skill Development Mission, Pradhan Mantri Kaushal Vikas Yojana, Science for Equity Empowerment and Development, Stand-Up India, Start-Up India, Support to Training and Employment Programme for women, Trade-Related Entrepreneurship Assistance and Development, USAID		

Course Learning Outcomes: On completion of the course, the student shall be able to:

- Understand the concept of entrepreneurship, its emergence and its need for society.
- Formulate a business idea and diagnose for a new business opportunity.
- Identify various business gaps and develop a business plan
- Evaluate and identify different institutional support available to the entrepreneur.

List of Professional Skill Development Activities (PSDA):

- Research on growth profile of an entrepreneur
- Identify opportunity, generate idea and conduct feasibility Analysis
- Design a Business Plan
- Develop an Entrepreneur Journal where reflection and personal experiences will be recorded
- Write personal insights, lessons learned, other readings, and the video clips you watch in this semester
- Interview one entrepreneur mentor and come up with five good business questions you would like to ask him or her
- Comparative study of startups in the field of Biopharmaceuticals, Bioagriculture, Bioindustry, and Bioservices.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Evan J. Douglas	Entrepreneurial Intention: Past, Present, and Future Research	Edward Elgar Publishing	2020	978-1-78897-522-3	216
Justin G. Longenecker, J. William Petty, Leslie E. Palich, and Frank Hoy	Small Business Management: Launching & Growing Entrepreneurial Ventures (20 th Edition)	Cengage	2023	978-0-3577-1880-3	712
Mike Kennard	Innovation and Entrepreneurship	Routledge	2021	978-0-367-51057-2	114
Debasish Biswas and Chanchal Dey	Entrepreneurship Development in India	Routledge	2021	978-0-367-76219-3	117
Robert D. Hisrich, Micheal P. Peters, Dean A. Shepherd, Sabyasachi Sinha	Entrepreneurship (11 th Edition)	McGraw Hill	2020	978-9390113309	696
Donald F. Kuratko and Jeffrey S. Hornsby	New Venture Management: The Entrepreneur's Roadmap for Development, Management, and Growth (3 rd Edition)	Routledge	2020	978-0367466725	356
Bruce R. Barringer and R. Duane Ireland	Entrepreneurship: Successfully Launching New Ventures (6 th Edition)	Pearson	2019	978-1-292-25533-0	617
Norman M. Scarborough and Jeffrey R. Cornwall	Essentials of Entrepreneurship and Small Business Management (9 th Edition)	Pearson	2019	978-1-292-26602-2	827
Mary Jane Byrd and Leon Megginson	Small Business Management: An Entrepreneur's	McGraw Hill	2017	978-1259538988	496

	Guidebook (8 th Edition)				
Robert D. Hisrich and Veland Ramadani	Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization	Springer	2017	978-3-319-50465-0	230
Stephen Spinelli, Jr. and Robert J. Adams, Jr.	New Venture Creation: Entrepreneurship for the 21st Century (10 th Edition)	McGraw-Hill Education	2016	978-0-07-786248-8	484
David H. Holt	Entrepreneurship: New Venture Creation	Pearson	2016	978-9332568730	584
Peter F. Drucker	Innovation and Entrepreneurship	Harper Business	2006	978-0060851132	288
Robert J. Calvin	Entrepreneurial Management	McGraw-Hill	2005	9780071450928	295
Steve Mariotti	Entrepreneurship and Small Business Management	Pearson publishers	2014	978-0133767186	

Programming in Python Lab

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
0	0	4	0	2

Course Contents/syllabus:

List of Experiments

(Total:36 Hours)

1. Compute sum, subtraction, multiplication, division and exponent of given variables input by the user.
2. Compute area of following shapes: circle, rectangle, triangle, square, trapezoid and parallelogram.
3. Compute volume of following 3D shapes: cube, cylinder, cone and sphere.
4. Compute and print roots of quadratic equation $ax^2+bx+c=0$, where the values of a, b, and c are input by the user.
5. Print numbers up to N which are not divisible by 3, 6, 9,, e.g., 1, 2, 4, 5, 7,....
6. Write a program to determine whether a triangle is isosceles or not?
7. Print multiplication table of a number input by the user.
8. Compute sum of natural numbers from one to n number.
9. Print Fibonacci series up to n numbers e.g. 0 1 1 2 3 5 8 13.....n
10. Compute factorial of a given number.
11. Count occurrence of a digit 5 in a given integer number input by the user.
12. Print Geometric and Harmonic means of a series input by the user.
13. Evaluate the Arithmetic expressions.
14. Print all possible combinations of 4, 5, and 6.
15. Determine prime numbers within a specific range.
16. Count number of persons of age above 60 and below 90.
17. Compute transpose of a matrix.
18. Perform following operations on two matrices.
 - 1) Addition
 - 2) Subtraction
 - 3) Multiplication
19. Count occurrence of vowels.
20. Count total number of vowels in a word.
21. Determine whether a string is palindrome or not.
22. Perform following operations on a list of numbers:
 - 1) Insert an element
 - 2) delete an element
 - 3) sort the list
 - 4) delete entire list
23. Display word after Sorting in alphabetical order.
24. Perform sequential search on a list of given numbers.
25. Perform sequential search on ordered list of given numbers.
26. Maintain practical note book as per their serial numbers in library using Python dictionary.
27. Perform following operations on dictionary
 - 1) Insert
 - 2) delete
 - 3) change
28. Check whether a number is in a given range using functions.

29. Write a Python function that accepts a string and calculates number of upper case letters and lower case letters available in that string.
30. To find the Max of three numbers using functions.
31. Multiply all the numbers in a list using functions.
32. Solve the Fibonacci sequence using recursion.
33. Get the factorial of a non-negative integer using recursion.
34. Write a program to create a module of factorial in Python.

Course Learning Outcomes: After studying this course students will be able to:

1. Explain environment, data types, operators used in Python.
2. Compare Python with other programming languages.
3. Outline the use of control structures and numerous native data types with their methods.
4. Design user defined functions, modules, files, and packages and exception handling methods.
5. Learn to handle exceptions in Python.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Programming in Python	Programming in Python	BPB	2017	978-9386551276
R. Nageswara Rao	Core Python Programming	Dreamtech Press	2021	978-9390457151
Martin C. Brown	Python, The complete Reference	Tata Mc. Graw Hill	2018	978-9387572942
A. Martelli, A. Ravenscroft, S. Holden	Python in a Nutshell	Shroff/O'Reilly	2017	978-9352135400

Semester 6

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				6th Semester					
S. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Malting & Brewing Technology	Core Course	4	0	2	0	0	6
2		Food Safety and Laws	Core Course	4	0	2	0	0	6
3		Food Plant Sanitation	Specialization Elective Courses	4	0	0	0	0	8 (Any two)
4		Bakery Technology	Specialization Elective Courses	3	0	1	0	0	
5		Technology of Frozen Foods	Specialization Elective Courses	4	0	0	0	0	
6		Technology of Snack Foods	Specialization Elective Courses	4	0	0	0	0	
7		Biosensors/MOOCs	Skill Component	2	0	0	0	0	2
8		Research Methodology/MOOCs	Skill Component	2	0	0	0	0	2
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.

Malting & Brewing Technology

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Course Contents/syllabus:

Malting & Brewing Technology	Teaching Hrs
UNIT I: Composition of Barley	18 h
Composition and structure of barley, Preparation and storage of barley for malting Characteristics of barley for malting, malting operations: Steeping, germination, kilning and modification,	
UNIT II: Malt composition and brewing operations	18 h
Composition of malt, brewing operations, Grinding, Mashing: changes during mashing, Filtration of wort	
UNIT III: Malting and Fermentation Process	18 h
Sparging and boiling, changes during boiling, Hops, characteristics of hops, selection of hops, Acidification of mash, Wort cooling.	
UNIT IV: Beer Manufacturing	18 h
Beer manufacturing, Wort production, Fermentation, Pasteurization, Types and characteristics of beer.	

Lab/ Practical details:

(72 Hours)

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

1. Determination of moisture content of barley.
2. To determine the seed germination capacity of barley.
3. Determination of % protein content of barley.
4. Determination of amount of husk in barley.
5. Preparation of malt.
6. To determine the length of acrospires.
7. Determination of Total Soluble Solids and Total Solids of malt.
8. Determination of % reducing sugars in malt.

Course Learning Outcomes

- ▶ Understanding the physico-chemical composition of barley for high quality beer production.
- ▶ Understanding about the steps involved in malting and brewing before beer production
- ▶ Know-how about improving the flavor and sensory of beer.
- ▶ Understanding how enzymes help in improving the texture of meat and meat products and eggs
- ▶ Enzymes and their applications in beer manufacturing.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages

D E Briggs; J S Hough	Malting and Brewing Science Vol. I:	London ; New York : Chapman and Hall,	1995	9780412165801	
Lewis and Young	Malting and Brewing Science Vol. II:	Kluwer Academic/Plenum Publishers,	2002	9780834219809	398

Food Safety and Law

Course Contents/syllabus:

L	T	P	SW/FW	Total Credit Units
4	0	2	0	6

Food Safety and Law

Units	Teaching Hrs
UNIT I: Introduction to Food Safety	18 h
Definition of safe food; Types of hazards; Factors affecting Food Safety; Importance of Safe Foods; Role of communication and training in food safety Hazards associated with food Mode of entry of hazards in food; Physical hazards-common examples and control measures; Chemical hazards, Packaging material as a threat, Impact on health Biological hazards (Food borne pathogens: bacteria, viruses and eukaryotes), Seafood and Shellfish poisoning, Mycotoxins, Indicator Organism	
UNIT II: Food Laws and Standards	18 h
Introduction to Standards, Specifications and limits National Food Regulation-FSSAI and important regulatory Agencies –FSSAI, BIS, APEDA; International regulatory scenario and role of organizations - Codex, WHO, FAO, ICMSF	
UNIT III: Hazards management	18 h
Critical parameters in hazards management; Design of food plant, Temperature, Danger Zone and Storage of Food, Role of Handler, Personnel hygiene, Quality of water and its analysis, General principles of hygiene, Hygiene and Sanitation in Food Service Establishments -Sources of contamination, Sanitation and methods of control using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Effluent Treatment Plant system Food Safety Management Tools Basic Concept, Prerequisite programs, HACCP, ISO series, TQM - components of TQM; Risk Analysis, Accreditation and Auditing	
UNIT IV: New and Emerging Pathogens	18 h
New and Emerging Pathogens; Genetically Modified Foods \ Transgenics, Organic foods and labelling, Trends in Food Safety, Food Frauds, Recent Journal references	

Lab/ Practical details: **(72 Hours)**

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

1. Preparation of different types of media (complex, differential and selective)
2. Culture of air borne pathogens using PDA
3. Identification of Molds by lactophenol blue staining
4. Gram Staining
5. Analysis of bacteria in food
6. Bacteriological Analysis of Water by MPN method
7. Surface sterilization assessments
8. Assessment of personal hygiene

Course Learning Outcomes

- Understanding food safety and hazards associated with food
- Awareness about food laws and standards, FSSA and important regulatory agencies
- Learning about hazards management in food industry
- Learning food safety management tools like HACCP, ISO series, TQM

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Blackburn, C.D.W. and Mc Clure, P.J.	Food borne pathogens. Hazards, risk analysis & control	Cambridge: Woodhead, 2001.	2005	9781855734548	521
De Vries	Food Safety and Toxicity	New York: CRC	1997	9780849394881	349
Marriott, Norman G.	Principles of Food Sanitation	SPRINGER,	2019	9783030097929	467
Mortimore S. and Wallace C.	HACCP-A Practical Approach.	Boston, MA Springer US	2018	9783319671642	437

Food Plant Sanitation

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

Course Contents/syllabus:

Food Plant Sanitation	
Units	Teaching Hrs
UNIT I: Food Plant Layout and Equipment Design	
General principles of food plant Design and layout Design of food processing equipments: Size Reduction, Mixing, Separation, Extraction, Extrusion, Drying, Freezing, Filtration, Centrifugation, Distillation, Gas absorption equipments	18 h
UNIT II: Warehousing and Cold Chain Management	
Food hygiene and safety in transportation, with a focus on warehouse storage and refrigerated ships- Safe food storage at shopping outlets: use of coolers/chillers/freezers, length of time in storage Design of warehouses Scope of Cold Chain for enhancing marketing potentials of perishables in domestic and international markets, Principle of FIFO. Principles of Cold Chain Creation and Management. Physicochemical changes in stored products during storage Airtight, Non-air tight, Underground, Conventional & Modern storage structures for fruits, vegetables, meat and marine products Aerated, refrigerated and controlled atmospheric storage. Layout and Design of storage structures, economics of storage structures	18 h
UNIT III: Food Plant Hygiene and Sanitation	
Waste disposal, Control methods using Physical and Chemical Agents Pest and Rodent Control ETP Design and Layout Food storage sanitation, transport sanitation and water sanitation. Guidelines of ISO 22000 for hygiene and sanitation of food processing plant. Clean In Place (CIP) Systems	18 h
UNIT IV: Wastewater and solid waste treatment	
By-products utilisation obtained from dairy plant, egg& poultry processing industry and meat industry. Wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.	18 h

Course Learning Outcomes

- Learning principles of food processing plant designing and layout
- Know-how of warehouse structure and principles of cold chain management
- Understanding food plant sanitation and hygiene
- Utilization of food industry waste into by products

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Fellows, P.	Food Processing Technology, 2nd Edition.	Woodhead Publishing Limited and CRC Press LLC.	2000	9780323857376	962
Food and Agriculture Organization of the United Nations & International Institute of Refrigeration	Design and operation of cold stores in developing countries,	FAO agricultural services bulletin. Food and Agriculture Organization of the United Nations.	1984	925101373X 9789251013731	80
Forsythe, S.J. and Hayes, P.R.	Food Hygiene, Microbiology and HACCP	Gaitersburg, Maryland: Aspen	1998	9781441951960	467
Hui, Y.H., Bruinsma, B., Gorham, R., Nip, W.-K.	Food Plant Sanitation.	New York: Marcel Dekker.	2003	9780824707934	745
James, A.	The supply chain handbook.	Distribution group	2013	9781930426030	494
Norman, G. Marriott. and Robert, B. Gravani.	Principles of Food Sanitation, 5th edition		2006	9783030097929	467
Rao, D. G.	Fundamentals of Food Engineering.	PHI learning Private Ltd.	2010	9788120338715	614
Rees, N. and D. Watson.	International Standards for Food Safety.	Gaitersburg, Maryland: Aspen	(2000).	9780834217683	276

Bakery Technology

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

Course Contents/syllabus:

Lab/ Practical details:

(36 Hours)

Objective: The laboratory exercises in this section have been so designed that the students

BAKERY TECHNOLOGY	Teaching Hrs
UNIT I: Bakery industry	13 h
Introduction to bakery technology, current status, growth rate, and economic importance of bakery Industry in India. Types of bakery products, nutritional quality and safety, pertinent standards & regulations, safety concerns related to additives used in bakery products.	
UNIT II: Breakfast cereals and Macaroni products	14 h
Bread, Buns and Pizza base Ingredients & processes for breads, buns, pizza base, changes taking place during baking, equipment used, product quality characteristics, faults, and corrective measures	
UNIT III: Cakes & Pastry	13 h
Ingredients & processes for cakes, equipment used, product quality characteristics, faults, and corrective measures. Different types of icings. Ingredients & processes for pastry, product quality characteristics, faults and corrective measures.	
UNIT IV: Biscuits, Cookies & Crackers	14 h
Ingredients & processes, equipment used, product quality characteristics, faults and corrective measures. Modified bakery products Modification of bakery products e.g. high fibre, low sugar, low fat, gluten free bakery products, fat and sugar replacers, enzymes, egg replacers and natural preservatives	

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

1. Preparation of bread and assessment of its quality
2. Preparation of buns and assessment of quality
3. Preparation of butter cake and assessment of its quality.
4. Preparation of sponge cake with icing and assessment of its quality.
5. Preparation of cookies and assessment of quality.
6. Preparation of biscuits and assessment of quality.

Course Learning Outcomes

- Knowing about history and development in bakery technology, its current status, and relevance of bakery industry in India.
- Understanding about technology and science of breakfast cereals, processing, packaging and latest developments
- Understanding the science of cake and pastry manufacturing
- Learning about technology of biscuits, cookies and other modified bakery products

Text / Reference Books:					
Author	Title	Publisher	Year of publication	ISBN	Pages
Barndt, R. L.	Fat & Calorie – Modified Bakery Products.	US: Springer.	1993	978-1-4615-3114-2	--
Corke, H., De Leyn, I., Nip, W.K. and Cross, N.A.,	Bakery products: Science and Technology.	John Wiley & Sons.	2014	9781119967156	761
Manley, D. ed.	Manley's technology of biscuits, crackers and cookies.	Elsevier.	2000	9781855735323	499

Technology of Frozen Foods

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

Course Contents/syllabus:

Technology of Frozen Foods	Teaching Hrs
Unit I: Introduction to Frozen Food Industry	14 h
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: Innovations in Freezing Processes	13 h
Innovation in freezing process, freeze concentration, de-hydro freezing, 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	14 h
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	13 h
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 concepts of food freezing technology.
- Acquire knowledge about equipment and process used for food freezing.
- Understand maintenance of quality of frozen food.
- Perceive knowledge of advanced packaging technology of frozen foods

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 and Packaging, Second Edition,	CRC Press	2011	9781138627147	936

Evans J. A.	Frozen Food Science and Technology	Wiley- Blackwell.	2011	9781444302325	355
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Technology of Snack Foods

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

Course Contents/syllabus:

Technology of Snack Foods	Teaching Hrs
Unit I: Introduction to Extrusion Technology	18 h
Extrusion: Introduction to extruders and their principles, types of extruders. Extruders in the food industry: History and uses. Single screw extruder: principle of working, factors affecting extrusion process, co-kneaders. Twin screw extruder: Feeding, screw design, screw speed, screw configurations. Pre-conditioning of raw materials used in extrusion process: operations and benefits and devolatilization. Chemical and nutritional changes in food during extrusion. Addition and subtraction of materials, shaping and forming at the die. Post-extrusion processes- colouring, flavouring and packaging of extruded snack foods.	
Unit II: Breakfast Cereals	18 h
Breakfast cereals: Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products). Breakfast cereal-manufacturing processes (traditional and modern methods), High shear cooking process and steam cookers. Texturized vegetable protein: definition, processing techniques. Direct expanded (DX) and third generation (3G) snacks: types. Concept of junk & fried foods and their impact on human health.	
Unit III: Technology for grain-based snacks	18 h
Technology for grain-based snacks: Whole grains- roasted, toasted, puffed, popped, flaked. Coated grains- salted, spiced and sweetened. Formulation, processing and quality assessment of chips and wafers, papads, instant premixes of traditional Indian snack foods.	
Unit IV: Technology for fruit and vegetable-based snacks	18 h
Technology for fruit and vegetable-based snacks- chips, wafers; Technology for coated nuts- salted, spiced and sweetened chikkies. Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping.	

Course Learning Outcomes:

- Understand science of extrusion cooking.
- Demonstrate extrusion cooking
- Compare different breakfast cereals
- Perceive knowledge of technology of snacks manufacturing

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Booth, R. G.	Snack Food	CBS, New Delhi.	1997	9780442237455	401
Edmund, W. L. & Rooney, L. W.	Snack Foods Processing	CRC. London.	2001	9781566769327	639
Guy, R.	Extrusion Cooking: Technologies and Applications	CRC Press ; Cambridge, Eng. : Woodhead,	2001	9780849312076	206

Riaz, M. N.	Extruders in Food Applications	Technomic, Lanchester.	2000	9781566767798	225
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Semester 7

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				7 th Semester					
S. No.	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Nutraceuticals and Functional Foods	Core Course	4	0	0	0	0	4
2		Enzymes in Food Processing	Core Course	4	0	0	0	0	4
4		*Biochemical & Biophysical Techniques	Open Elective Courses	4	0	0	0	0	4
4		*Recombinant DNA Technology	Open Elective Courses	4	0	0	0	0	
5		Dissertation/thesis work	Non-teaching Credit Courses/supervised Independent Learning	0	0	12	0	0	12
			Total Credits						24

L: lecture; T: training; P: practical; FW: field work; SW: self-work.
***Tentative: Students will choose open elective course from other departments.**

Nutraceuticals And Functional Foods

Course content and syllabus

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

Nutraceuticals And Functional Foods	Total Teaching Hrs
UNIT I: Introduction to Nutraceuticals	18 h
Introduction Definitions and history Difference between nutraceuticals and functional foods Current status of nutraceuticals and functional foods in India Market trends of nutraceuticals and functional food	
UNIT II: Types of nutraceuticals and health benefits	18 h
Types of nutraceuticals: phytochemicals- isoprenoids, polyphenolics, phytosterols; carbohydrates- (dietary fibers, oligosaccharides and resistant starch); proteins and peptides, lipids- conjugated linoleic Acid, omega-3 fatty acids, fat replacers; vitamins and minerals; microbial- probiotics, probiotics and symbiotic; sources and stability of nutraceuticals Health benefits- cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action	
UNIT III: Functional Foods and health benefits	18 h
Types of functional foods - Cereal and cereal products, milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages (tea, wine), fermented foods. Potential health benefits and role in cardiovascular diseases, hypertension, and diabetes. Development, formulation and fabrication of functional foods.	
UNIT IV: Legal Aspects of food safety	18 h
Safety, Consumer acceptance, Assessment of health claims, Labelling, marketing and regulatory issues, Future prospects.	
Practical Nil	

Course Learning Outcomes

- Learning fundamentals of biological active biological molecules and their role in food
- Know-how about types of nutraceutical molecules and their roles in prevention of chronic diseases
- Study of functional foods from cereal, milk, fruits, vegetables, nuts and oilseeds.
- Understanding legal aspects, claims, labelling and ethical issues of functional foods

Text / Reference Books:					
Author	Title	Publisher	Year of publication	ISBN	Pages
Pathak, Y.V.	Handbook of nutraceuticals	CRC Press.	2011	9781420082210	400
Wildman, R.E.C.	Handbook of Nutraceutical	CRC Press	2001	9781498703727	336

	and Functional Foods.				
Various journals of food technology, food science and allied subjects					

Enzymes in Food Processing

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

Course Contents/syllabus:

Enzymes in Food Processing	Teaching Hrs
UNIT I: Enzymes in Food industry	18 h
Enzymes– classification, properties and mechanism of enzyme action, co-enzymes & activators, co-factors. Immobilized enzyme technology.	
UNIT II: Enzyme in starch processing and Baking Industry	18 h
Enzymes to produce maltodextrins, corn syrup solids, fructose, and fructo-oligosaccharides. Baking: fungal α -amylase for bread making; maltogenic α -amylases for anti-staling; xylanases and pentosanes as dough conditioners; lipases or dough conditioning; synergistic effect of enzymes.	
UNIT III: Enzymes in dairy industry	18 h
natural enzymes in milk, hydrogen peroxide-catalase treatment, rennin, lactose intolerance, enzymes in cheese making and whey processing. Fruit juices: cell wall degrading enzymes, clarification, peeling, debittering, anthocyanases and decolouring of dark coloured juices.	
UNIT IV: Enzymes in meat industry	18 h
Meat tenderization; enzymes in egg processing; Enzymes in brewing, mashing and beer finishing operations.	
Experiments nil.	

Course Learning Outcomes

- Knowing about the fundamentals of enzymes and its kinetics
- Understanding the role of enzymes in the production of different food products
- Understanding the application of enzymes in dairy and beverage industry
- Understanding how enzymes help in improving the texture of meat and meat products and eggs
- Enzymes and their applications in beer manufacturing.

Text / Reference Books:					
Author	Title	Publisher	Year of publication	ISBN	Pages
Nagodawithana T & Reed G.	Enzymes in Food Processing	Academic Press.	1993	9780125136303	480
Tucker GA & Woods LFJ.	Enzymes in Food Processing		1991	9780216929777	288
Whitehurst R & Law B.	Enzymes in Food Technology.	Blackwell Publ.	2002	9781405183666	368

Food Service Management

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

Course Contents/syllabus:

Food Service Management	Teaching Hrs
Unit I: Food Service Operations	18 h
Development and growth of the food service Industry. Classification of food service operations. Recent trends in food service. Systems approach to food service organizations. Types of food service systems. Menu Planning. Types of Menus, Menu presentation, Writing, Design and format Menu Marketing. Concept of Food flow. Procurement,	
Unit II: Food Service Management	18 h
Concept of Market, Buyer, Vendor and Marketing Channel Purchasing: Methods of purchasing, purchasing process. Receiving: Facilities needed for good receiving practices. Storage and Inventory. Production: Recipe formulation, Standardisation, Forecasting, Scheduling and control. Energy Management and Conservation	
Unit III: Kitchen Design and Layout	18 h
Kitchen Design and Layout. Service Factors affecting the choice of distribution systems. Styles of service and Service management. Food Safety and hygiene.	
Unit IV: Control of microbial growth in food processing operations	18 h
Control of microbial quality of food throughout the food flow. Food Handling and prevention of food borne illness. Personal Hygiene. Environmental Sanitation. Waste disposal and pest control. Standards for food safety and sanitation	

Course Learning Outcomes:

- Understand the scope of food service management in commercial and welfare organizations.
- Acquire knowledge about the process of food preparation and service.
- Perceive concepts of management, marketing and entrepreneurship with reference to food service

Author	Title	Publisher	Year of publication	ISBN	Pages
Bhojwani M	Food service management : Principles and practice	New Delhi, India : Rajat Publications , 2007.	2007	9788178802664	282
Delfakis H, Nancy L, Van Burns J	Food Service Management	Cincinnati, OH : South-Western Publ. Co.,	1992	9780538606936	354
Singh YP	Effective Food Management	Anmol Publications Pvt. Ltd.	2001	9788126107421	293

Biochemical & Biophysical Techniques

Course Contents/syllabus:

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

Biochemical and Biophysical Techniques

Units	Teaching Hrs
UNIT I: Centrifugation	18 h
Centrifugation: Basic principles of sedimentation, theory and applications of preparative and analytical centrifugation, Differential and density gradient centrifugation, Types of centrifugation machines and rotors, Sedimentation co-efficient, Factors affecting sedimentation coefficient, care of rotors.	
UNIT II: Spectroscopy	18 h
Spectroscopy: Basic Principle, Lambert Beer's law, Absorption spectrum, theory & principles of single and double beam UV/Visible spectroscopy, Basic Principle and instrumentation of FTIR, circular dichroism, Raman, fluorescent spectroscopy, NMR and ESR.	
UNIT III: Chromatography	18 h
Chromatography: Partition coefficient, Theory and Principle: Thin layer, paper and column chromatography, gel exclusion chromatography, Principle, and applications: cation-, anion-exchange chromatography, hydrophobic and reverse-phase chromatography, affinity chromatography.	
UNIT IV: Advanced Gas & Liquid Chromatography	18 h
Gas Liquid Chromatography, High Performance Liquid chromatography (HPLC), Fast Protein Liquid chromatography, (FPLC), UP-HPLC, nano-LC, SCX and SAX-nano HPLC.	

Course Learning Outcomes:

- Understand different biochemical and biophysical techniques
- Demonstrate protein purification by chromatography
- Compare DNA and RNA gel electrophoresis results
- Perceive knowledge of different spectroscopic techniques

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Wilson K. and Walker J. (Eds.)	Practical Biochemistry: Principles and Techniques	Cambridge University Press, U.K.	2018	9780521799652	784

Recombinant DNA Technology

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

Recombinant DNA Technology	Teaching Hours
Unit I: Gene Cloning and DNA Analysis	13 h
Polymerase chain reaction, DNA modifying enzymes: polymerases, kinases, ligases, phosphatases; Primers designing, Purification of DNA fragments, Restriction enzymes, DNA ligation, Vectors, DNA Transformation, Genomic DNA and Plasmid Isolation, Restriction digestion and DNA Analysis by gel electrophoresis.	
Unit II: VECTORS FOR GENE CLONING AND DNA MANIPULATION	14 h
Cloning vectors based on E. coli plasmids, Cloning vectors based on M13 bacteriophage, Cloning vectors based on λ bacteriophage, λ and other high-capacity vectors enable genomic libraries to be constructed, Vectors for other bacteria; Vectors for yeast and other fungi, Cloning vectors for higher plants, Cloning vectors for animals	
Unit III: CLONING A SPECIFIC GENE	13 h
The problem of selection, Direct selection, Identification of a clone from a gene library, Methods for clone identification. online servers/software for DNA and protein analysis: Acquiring DNA sequence encoding the protein of interest (for example GFP) from online database like PUBMED and PDB. Analysis of DNA sequence for presence of internal restriction digestion sites etc	
Unit IV: ADVANCED CLONING TECHNIQUES	14 h
Homologous recombination, Zinc finger nucleases (ZFN), Transcription activator-like effector nucleases (TALENs), The CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats) system	

List of Experiments - with basic instructions (Total Teaching = 36 hrs)

1. Acquiring DNA sequence encoding the protein of interest (for example GFP) from online database like PUBMED and PDB. Analysis of DNA sequence for presence of internal restriction digestion sites etc.
2. Primer designing: Designing of 5' forward and 3' reverse complementary primers containing appropriate restriction digestion sites, affinity tags (penta-His etc.).
3. PCR amplification of the DNA segment of interest from a suitable source.
4. Restriction digestion, and subsequent ligation into the suitable bacterial expression vector (also containing an antibiotic resistant marker) of interest.
5. Transformation into suitable competent cells (BL21 etc.). (Students will learn how to prepare E. coli competent cells).
6. Selection of the antibiotic resistant single colony.
7. Plasmid isolation from the transformed cells and sequencing it to confirm the sequence of cloned DNA segment of interest.

Course Learning Outcomes:

- Understand basic concepts of DNA manipulation.
- Understand the procedure of gene cloning
- A thorough understanding of vectors
- Perceive knowledge of advanced gene editing methods

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
J. Sambrook, E. F. Fritsch, and T. Maniatis, 2nd Edn.,	Molecular cloning: a laboratory manual	Cold Spring Harbor Laboratory Press	1989	0879695765	2344
T.A. Brown	Gene Cloning and DNA Analysis - An introduction	Wiley Blackwell	-2010	9781405181730	338

Research Project

L	T	P	Total Credits
0	0	12	12

Course content and syllabus

The student will undertake a research project under the supervision of a faculty member.

Semester 8

B.Sc. (H) Food Science Technology and Processing (4 year)									
Semester-wise Distribution of Courses				8th Semester					
S. No.	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Industrial Microbiology	Core Course	4	0	0	0	0	4
3		Emerging Biochemical and Biophysical Techniques	Specialization Elective Courses	4	0	0	0	0	4 (Any one)
4		Advanced Food Preservation Technology	Specialization Elective Courses	4	0	0	0	0	
7		*IPR, Biosafety and Bioethics	Open Elective Courses	4	0	0	0	0	4 (Any one)
9		*Plant Biotechnology	Open Elective Courses	4	0	0	0	0	
10		Dissertation/thesis work	Non-teaching Credit Courses/supervised Independent Learning	0	0	12	0	0	12
			Total Credits						24

L: lecture; T: training; PS: practical session; FW: field work; SW: self-work.
*Tentative: Students will choose open elective course from other departments.

Industrial Microbiology

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

Industrial Microbiology	Teaching Hours
Unit I: Introduction to industrial microbes	18 h
Microorganisms of industrial importance – yeasts (<i>Saccharomyces cerevisiae</i>), moulds (<i>Aspergillus niger</i>) bacteria (<i>E. coli</i>), actinomycetes (<i>Streptomyces griseus</i>). Industrially important Primary and secondary microbial metabolites. Screening techniques. Techniques involved in selection of industrially important metabolites from microbes.	
Unit II: Industrial fermentation methods	18 h
Theory and principles of industrial fermentation, Batch, fed batch and continuous cultures. Isolation, preservation and improvement of industrially important micro-organisms, inoculum development for industrial fermentations, fermenter design, various types of fermenters used in industrial fermentation. Basic principle of microbial fuel cells and its application.	
Unit III: Industrial applications	18 h
Microorganisms involved in Pharma and therapeutic enzymes. Enzymes used in detergents, textiles, and leather industries. Production of amylases and Proteases. Production of therapeutic enzymes.	
Unit IV: Case studies	18 h
Microbial production of Industrial products: Citric acid, Ethanol, Penicillin, Glutamic acid, and vitamin B12. Role of microorganisms in bioleaching and textile industry.	
Experiments Removed	

Course Learning Outcomes:

- Learning of different fermentation techniques, bioreactor design, inoculum development for industrial fermentations, Microbial growth and product formation kinetics, media formulation and sterilization, isolation, preservation and improvement of industrially important micro-organisms.
- Understanding of industrial production and purification of organic acids, alcohols, wine and vinegar with help of different microbes.
- Understanding of industrial production and purification of antibiotics, enzymes, amino acids and steroids.
- Understanding of different pathways followed in or by the microbes involved in production of these bio-chemicals. Method of manipulating these pathways to get desired yield.
- Understanding of application of these biomolecules in benefit of mankind

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Pelczar, M.J. Jr., Chan ECS and Krieg, N.R.	Microbiology: Concepts and Applications	New York; Madrid: McGraw-Hill,	1993	0070492581, 9780070492585	957

Cappucino, J.G.	Microbiology-A laboratory manual, 4th ed., Harlow, Addison-Wesley.	Hoboken, N.J.: Pearson	2020	0135188997, 9780135203996, 01352039	541
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Emerging Biochemical and Biophysical Techniques

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

Emerging Biochemical and Biophysical Techniques	Total Teaching Hrs
UNIT I: Electrophoresis	18 h
Electrophoresis: Introduction to IEF (Iso-electric focusing), electrophoresis, Applications of electrophoresis and molecular weight.	
UNIT II: Mass spectroscopy	18 h
Mass spectroscopy: Ionization methods and Analysers, MALDI-ToF and MALDI Q ToF, Applications of mass spectroscopy in Food Technology for qualitative and quantitative analysis of raw and processed food material. Introduction to fluorescence spectroscopy	
UNIT III: Advanced Biochemical and Biophysical Techniques	18 h
HPLC, UPHPLC, XRD analysis of starches (X-RAY), FTIR, Raman spectroscopy, FESEM, Atomic force microscopy, SEM, TEM	
UNIT IV: Advanced Food Quality Analysis	18 h
Food Quality Analysis: Texture Analyzer; Rheometer; Rapid visco analyzer, DSC, zeta potential analysis; particle size analysis; Amino acid Analysis.	

Course content and syllabus

Course Learning Outcomes:

- Understand different biochemical and biophysical techniques
- Demonstrate protein separation by 2D gel electrophoresis
- Compare MALDI ToF/MS results
- Perceive knowledge of different Food analysis instrumentation techniques

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Wilson K. and Walker J. (Eds.)	Practical Biochemistry: Principles and Techniques	Cambridge University Press, U.K.	2018	9780521799652	784

Advanced Food Preservation Technology

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

Course content and syllabus

Advanced Preservation Technology	Total Teaching Hrs
UNIT I: Cold Plasma Technology	18h
Cold Plasma Technology: Introduction to Green Chemistry, EU and US Law on Sustainable Food Processing, application of cold plasma technology in food.	
UNIT II: Plasma-Activated Water and Gaseous Chlorine Dioxide	18 h
Plasma-Activated Water and Gaseous Chlorine Dioxide: A Chlorine Alternative for Packaging Solution. Advances in Critical Fluid Processing, Supercritical Fluid Pasteurization and Food Safety.	
UNIT III: Membrane Separations in Food Processing	18 h
Membrane Separations in Food Processing, High Hydrostatic Pressure Food Processing, High intensity Pulsed Light Food Processing; Application of Pulsed Electric Fields in food technology	
UNIT IV: Ultrasonic Food Processing	18 h
Ultrasonic Food Processing; Radio Frequency Pasteurization; Microwave-assisted Solvent Extraction (MASE); Continuous Pasteurization and Sterilization of Liquid Food	

Course Learning Outcomes:

- Understand alternative food processing and preservation techniques
- Demonstrate application of plasma activated water in food preservation
- Compare membrane separation and high hydrostatic pressure technology
- Perceive knowledge of ultrasonic food processing

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Niemira B.A.	Alternatives to Conventional Food Processing	Cambridge, UK: RSC Publishing,	2018	9781849730372	481
O' Donnell, C., (Editor), Tiwari, B. K., (Editor), Cullen, P. J. et al.,	Ozone in Food Processing	Wiley-Blackwell,	2012	9781444334425	298

Plant Biotechnology

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

Plant Biotechnology	Teaching Hours
Unit I: Introduction to Plant biotechnology	18 h
Plant tissue culture—its history, development and applications, Plant tissue culture media, Types of cultures, Callus cultures, Cell and suspension cultures, Single cell clones, Protoplast culture and somatic hybridization. Micropropagation: Techniques and various steps involved in micropropagation, Production of disease-free plants, Commercial aspects and limitations of micropropagation	
Unit II: Production of haploid plants and Embryo culture	18 h
Production of haploid plants: Androgenesis and Gynogenesis and production of homozygous lines, Significance and uses of haploids. Embryo culture and embryo rescue and its applications in plant improvement.	
Unit III: Secondary metabolite extraction and Germplasm conservation	18 h
Primary vs secondary metabolites, Production of secondary metabolites and other compounds using plant cell culture, Hairy root culture, Immobilized cell system, Elicitation and Biotransformation. Germplasm conservation: various approaches for Bioconservation, in vitro techniques especially cryopreservation in germ plasm conservation	
Unit IV: Recombinant DNA technology and Molecular farming	18 h
Recombinant DNA Technology and Manipulation of Phenotypic Traits: Strategies of molecular cloning of plant genes, Gene transfer methods—Vector mediated, Virus mediated and Vector less DNA transfer, rDNA approaches for introducing herbicide tolerance, pest resistance, plant disease resistance, Abiotic & biotic stress tolerance, Improvement of crop yield and quality, Molecular markers and marker assisted selection, Applications of plant transformations/ transgenics, Commercial transgenic crops. Molecular farming: of Alkaloids, Useful enzymes, Therapeutic proteins, custom- made Antibodies, Edible vaccines.	

Course Learning Outcomes:

Students will be able to:

- Acquire the knowledge about the techniques of Plant Tissue Culture, Lab. organization and measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.
- Learn the techniques of culturing tissues, single cells, protoplasts & anther culture, germplasm conservation and cryobiology
- Learn the large-scale clonal propagation of plants through various micropropagation techniques, Production of secondary metabolites under in vitro conditions
- A good understanding of r-DNA technology, methods of gene transfer, molecular markers and markers assisted selection
- Develop transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
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Slater, A., Scott, N.W., and Fowler, M.R.	Plant Biotechnology	Oxford University Press	2 nd /2008	0199560870	400
Razdan, M.K.	Introduction to Plant Tissue Culture	Science Publishers	2 nd /2003	9788120417939	420
Primrose, S.B. and Twyman, R.M	Principles of Gene Manipulation and Genomics	Blackwell Publishing	7 th /2006	8126548398	554
Satyanarayana, U	Yeast Biotechnology: Diversity and Applications	Springer	2009	1402082916	744

IPR, Biosafety and Bioethics

L	T	P	Total Credits
4	0	0	4

Course Contents/syllabus:

IPR, Biosafety and Bioethics	Teaching Hours
Unit I: Introduction to IPR and Patent Database	18 h
<p>Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.</p> <p>Protection of New GMOs: International framework for the protection of IP. IPs of relevance to Biotechnology and few Case Studies.</p> <p>Patent databases: Invention in context of “prior art”; Searching national/International Databases; Analysis and report formation</p>	
Unit II: Types of patent and patent application	18 h
<p>Types of patents: Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application</p>	
Unit III: Biosafety, GMOs and Biodiversity Act	18 h
<p>Biosafety: Introduction; Historical Background: Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India;</p> <p>Definition of GMOs & LMOs: Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis;</p> <p>Risk Assessment: Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.</p> <p>Biodiversity Act 2002: Agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; Climate change and conservation of plant genetic resources; Global efforts for management of crop genetic resources; Strategies on PVFR and Biodiversity Acts.</p> <p>Biodiversity Legislation in India; Indian Biodiversity Act and provisions on crop</p>	
Unit IV: Bioethics, Ethics and the law issues	18 h
<p>Bioethics: Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology;</p> <p>Ethics and the Law Issues: types and policies; Research concerns; Emerging issues: Biotechnology’s Impact on Society; DNA on the Witness Stand - Use of genetic evidence in civil and criminal court cases; Challenges to Public Policy – To Regulate or Not to Regulate; Improving public understanding of biotechnology products to correct misconceptions.</p>	

Course Learning Outcomes:

- Understand IPR and its database.
- Evaluate different types of patents and policies
- Compare the biosafety methods and differences between GMOs and LMOs.
- Perceive knowledge of Bioethics and laws.

Text / Reference Books:

Author	Title	Publisher	Ed/yea r	ISBN No	Pages
D N Choudhary	Evolution of patent laws: "developing countries' perspective	Delhi Capital Law House	2006	OCLC Number: 255182178	476

Research Project

L	T	P	Total Credits
0	0	12	12

Course content and syllabus:

The student will undertake a research project under the supervision of a faculty member.

