1.2.2

Supporting Documents-

Department of Food Science & Technology

Copy of Syllabus of All Programs Offered Indicating Credits/Electives Approved by Board

Scheme & Syllabus of

Master of Science- Food Technology

(M. Sc. of Food Technology)

Batch 2019 onwards

By

Board of Study (Food Science and Engineering)
(Main Campus)

Department of Food Science and Technology
IK Gujral Punjab Technical University

Vision:

To create competent professionals those, contribute towards the economic development of the nation by going in line with the policy of Government of India in the field of food processing food safety and security.

Mission:

- Development of human resources in the field of food science and technology to serve the cause of nation
- Providing a strong theoretical and practical background across the food science discipline with an emphasis on developing sustainable resources to cater food and nutrition related challenges
- Development of human resources in the area of clinical nutrition and research to contribute effectively in making India healthy
- Create favorable environment for innovation to translate theoretical knowledge into practical applications
- Inculcating professional ethical values, innovative research capabilities and leadership abilities
- Holistic development of the youth through the process of self evaluation and continuous improvement

Program Education Objectives:

1. The interdisciplinary nature of the MSc. Food Science & Technology course prompts intake of students from mixed disciplines creating the need to bring students from varying academic backgrounds to a common platform of understanding through courses structured to meet this need.
2. To make the students competent in developing the foods of the future by utilizing technologies such as food fermentations, applications of enzymes in food processing, food product development, nutraceuticals, nutritional and functional foods.
3. To keep students abreast with the rapid developments reported within technology and biological science that is creating completely new ways of developing various processed food.
4. To impart an understanding of modern food processing and profound knowledge of technology associated with the development of healthy and safe foods.
5. To motivate and enable students of MSc. Food Science & Technology to opt for higher levels of learning viz. doctoral programs by research in this interdisciplinary field with the view of developing highly skilled professionals to work in Industry and academia.

Program Outcomes:

1. An ability to apply the knowledge of science, microbiology and technology
2. An ability to apply the knowledge of underlying chemistry, properties and effects of processing on food components
3. An ability to use the techniques, skills, and modern tools necessary food processing operations
4. Demonstrate knowledge and understanding of technology and management principles, manage projects efficiently in food science and technology and multidisciplinary environments after consideration of economical and financial factors
5. An ability to design and conduct experiments, as well as to analyze and interpret data
6. An ability to apply knowledge for production of safe food and shelf-life extension of food products
7. An ability to identify, formulates, and solve food science and technology problems
8. An ability to extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data
9. Contribute individually/in group(s) to the development of scientific/technological knowledge in food science and technology.

Mapping of Program Outcomes with Program Education Objectives:-

PEO / PO	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	1	1	2
PO2	3	1	1	1	2
PO3	1	3	1	1	1
PO4	2	2	1	1	2
PO5	1	1	2	1	1
PO6	1	2	1	3	1
PO7	1	3	3	3	1
PO8	1	1	3	3	3
PO9	2	2	2	1	3

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)

Eligibility for Admission:
Bachelor of Science / Applied Science in any subject/ B. Tech Food Technology / Biotechnology/ Sugar Technology/ Sugar and Alcohol Technology/ Fermentation Technology / Dairy Technology/B.Voc. (Food Science & Technology/Agri Food Technology/Food Processing) /Bachelor in Hotel Management and Catering Technology or any other examination recognized equivalent thereto with at least 50% marks in aggregate

Semester First

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-511- 19	Food Chemistry	4	-	-	30	70	100	4
UC-MSFT-512- 19	Principles of Food Engineering	4	-	-	30	70	100	4
UC-MSFT-513- 19	Food Microbiology	4	-	-	30	70	100	4
UC-MSFT-514- 19	Food Processing & Preservation	4	-	-	30	70	100	4
UC-MSFT-515- 19	Lab - I (Food Microbiology)	-	-	4	35	15	50	2
UC-MSFT-516- 19	Lab - II (Food Preservation & Analysis)	-	-	4	35	15	50	2
UC-MSFT-517- 19	Nutraceuticals & Functional Foods	4	-	-	30	70	100	4
	Total	**20**	**-**	**8**	**220**	**380**	**600**	**24**

Semester Second

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-521- 19	Dairy Technology	4	-	-	30	70	100	4
UC-MSFT-522- 19	Technology of Fruits & Vegetables	4	-	-	30	70	100	4
UC-MSFT-523- 19	Packaging Technology	4	-	-	30	70	100	4
UC-MSFT-524- 19	Lab - III (Dairy Technology)	-	-	4	35	15	50	2
UC-MSFT-525- 19	Lab - IV (Technology of Fruits & Vegetables)	-	-	4	35	15	50	2
UC-MSFT-526- 19	Lab - V (Packaging Technology)	-	-	4	35	15	50	2
UC-MSFT-527- 19 or 528- 19	Programme Elective-I	4	-	-	30	70	100	4
UC-MSFT-529- 19 or 530- 19	Programme Elective-I (Lab)	-	-	4	35	15	50	2
	Total	**16**	**-**	**16**	**260**	**340**	**600**	**24**

Programme Elective-I *

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-527- 19	Bioprocess Technology	4	-	-	30	70	100	4
UC-MSFT-528- 19	Technology of Beverages	4	-	-	30	70	100	4
UC-MSFT-529- 19	Lab - VI (Bioprocess Technology)	-	-	4	35	15	50	2
UC-MSFT-530- 19	Lab - VII (Technology of Beverages)	-	-	4	35	15	50	2

Note: * Select any one subject from Elective-I. The elective subject for theory & practical will be same.

Semester Third

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-611- 19	Technology of Cereals, Pulses & oilseeds	4	-	-	30	70	100	4
UC-MSFT-612- 19	Food Safety, Standards & Quality Control	4	-	-	30	70	100	4
UC-MSFT-613- 19	Agri Business Management	2	-	-	15	35	50	2
UC-MSFT-614- 19	Lab - VIII (Technology of Cereals, Pulses & oilseeds)	-	-	4	35	15	50	2
UC-MSFT-615- 19 or 616- 19	Programme Elective-II	4	-	-	30	70	100	4
UC-MSFT-617- 19 or 618- 19	Programme Elective-II (Lab)	-	-	4	35	15	50	2
UC-MSFT-619- 19	In-Plant Training	-	-	12		150	150	6
UC-MSFT-630- 19	Seminar	-	-	2	35	15	50	1
	Total	**14**	**-**	**22**	**220**	**430**	**650**	**25**

Programme Elective-II **

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-615-19	Food Additives	4	-	-	30	70	100	4
UC-MSFT-616-19	Nutrition & Health	4	-	-	30	70	100	4
UC-MSFT-617-19	Lab – IX (Food Additives)	-	-	4	35	15	50	2
UC-MSFT-618-19	Lab – X (Nutrition & Health)	-	-	4	35	15	50	2

Note: ** Select any one subject from Elective-II. The elective subject for theory & practical will be same.

Semester Fourth

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-621- 19	Snack Food Technology	4	-	-	30	70	100	4
UC-MSFT-622- 19 or 623- 19	Programme Elective-III	4	-	-	30	70	100	4
UC-MSFT-624- 19	Dissertation	-	-	24	200	100	300	12***
	Total	**8**	**-**	**24**	**260**	**240**	**500**	**20**

*****Non-credit (only satisfactory or un-satisfactory grade to be shown in DMC)**

Programme Elective-III for Fourth Semester ****

Corse Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
UC-MSFT-622- 19	Food Biotechnology	4	-	-	30	70	100	4
UC-MSFT-623- 19	Technology of Meat, Fish and Poultry	4	-	-	30	70	100	4

Note: **** Select any one subject from Elective-III.

Important Notes: -

1. The credit requirement for the M.Sc. degree in Food Technology is 92 credits inclusive of the 16 elective course credits.
2. One laboratory hour per week per semester will be assigned half credit.
3. No elective course will be run unless the number of students registered for the elective course is five or more.
4. Each theory paper and practical examination will be of 3 hours duration.
5. After the second semester, the students will be required to undertake an In-plant training comprising 4-6 weeks in industry/organization/institute and shall submit an In-plant (Industrial) Daily dairy with In-plant-training report for which seminar presentation and viva-voce examination will be held in the beginning of the third semester by a Departmental Research Committee (DRC) including the supervisor/mentor.
6. A student is required to undertake a Research Project of 12 credits on a topic approved by the supervisor and the Departmental Research Committee (DRC). The student is required to prepare his/her research project synopsis and should make a presentation to the DRC before the commencement of the final examination of third semester.
7. The research project shall be evaluated by the external examiner at the end of the Semester IV.
8. A Supervisor will be allotted by the Departmental Research Committee (DRC) for each student in the beginning of first semester.

SEMESTER

FIRST

UC-MSFT-511- 19: FOOD CHEMISTRY

Total Marks: 100	L	T	P
	4	0	0

Objective:
To acquaint the students about chemistry of various foods.

UNIT-I

Scope, introduction, definition and importance of food chemistry.

Chemistry of carbohydrates: Classification, functions, chemical and physical properties, pentosans, mannans and galactans, pectic substances, gums. Types of fibers and its constituents, Celluloses, hemicelluloses, soluble fibers, insoluble fibers and their important functions. Enzymes and starches-alpha amylase, beta amylase, modified starches, resistant starches, gelatinization of starches and starch blockers.

UNIT-II

Proteins and amino acids: Types, chemical, physical and functional properties, denaturation of protein, gel formation. Proteins from milk, egg and meat. Allergens, toxic constituents and anti-nutritional factors of foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing oligosaccharids, phytolectins).

UNIT-III

Fats and oils: Classification, functions, physico-chemical properties, oxidation of oils and fats, rancidity. Chemistry of emulsifiers, antioxidants, stabilizers and additives used in food industry. Chemical properties and functions of minerals and vitamins. Chemistry of pigments and flavour compounds.

UNIT-IV

Enzymatic and non-enzymatic browning in Foods, reactions of aldehydes and ketones with amino compounds, caramelization, oxidative changes of polyphenols) and their applications in food products.

Important chemical changes during storage and cooking of foods, with some suitable examples from cereals, pulses and fruits and vegetables.

Recommended Readings:

1. Wang, D. (2012). *Food Chemistry*: Nova Science Publishers.
2. Chopra, H. K. & Panesar, P. S. (2010). *Food chemistry*: Alpha Science International Ltd, Oxford, U.K.
3. Coultate, T. P. (2009). *Food: The Chemistry of Its Components* (5 ed.): American Chemical Society.
4. Newton, D.E. (2009). *Food Chemistry*: Facts On File, Incorporated.
5. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2007). *Fennema's Food Chemistry*: CRC Press, Taylor and Francis group.

Course Outcomes:

1. Students shall be aware of the underlying chemistry, properties and effects of processing on food components.
2. Understanding of food components reactions and their impact on sensory, nutritional, and functional properties of foods.
3. Ability to identify the structure of food constituents and relate the structure to the constituents function and importance in foods with respect to food quality, nutrition, safety, processing, etc.
4. Ability to explain influence of factors such as temperature, pH, ionic characteristic and strength, bonding, etc. on chemical changes in food systems and judge how to adjust these conditions to improve or minimize chemical and biochemical deterioration of food systems.
5. Ability to integrate chemistry and biochemistry principles into real-world food science and nutritional problems.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	1	1	2	2
PO2	3	2	2	2	2
PO3	1	2	2	1	1
PO4	1	2	2	2	2
PO5	1	1	1	1	1
PO6	2	3	3	3	3
PO7	3	3	3	3	3
PO8	1	2	2	2	2
PO9	2	3	3	3	3

UC-MSFT-512- 19: PRINCIPLES OF FOOD ENGINEERING

Total Marks: 100	L	T	P
	4	0	0

Objective:

The course provides principles of engineering mechanics applied to food processing operations.

UNIT-I

Introduction to food engineering. Material and energy balances- Basic principles, total mass and component mass balance. Material balance calculations involved in dilution, concentration and dehydration. Heat balance calculations. Fluid flow theory and application - Fluid statics and fluid dynamics, mass and energy balances in fluid flow. Newtonian and non-newtonian fluids, streamline and turbulent flow. Fluid flow applications- measurement of pressure and velocity. Liquid transport system. Pipelines and pumps for food processing plants-positive displacement pumps, air-lift pumps, propeller pumps, centrifugal pumps and jet pumps.

UNIT-II

Heat transfer in food processing- Thermal properties of foods, modes of heat transfer, conductive heat transfer in a rectangular slab, tubular pipe, and multilayered systems. Natural and forced convection. Estimation of convective heat transfer coefficient in forced and natural convection. Estimation of overall heat transfer coefficient. Heat exchangers- Plate, tubular, scraped surface, and steam infusion. Thermal process calculation- Commercial sterility concept, Microbial inactivation rates at constant temperature. Effect of temperature on thermal inactivation of microorganisms. Calculation of processing time in continuous flow systems.

UNIT-III

Psychrometrics- Properties of dry air, composition of air, specific volume of air, specific heat of dry air, enthalpy of dry air, dry bulb temperature. Properties of water-vapor- Specific volume, specific heat and enthalpy. Properties of air-vapor mixtures- Gibbs-Dalton law, Dew-point temp, humidity ratio, relative humidity, wet bulb temperature. The psychrometric chart- Use of psychrometric chart to evaluate complex air conditioning processes.

UNIT-IV

Material handling- theory and classification of various material handling equipments. Conveyors (gravity and powered conveyors), elevators (bucket and screw-type elevators), trucks (high lift and pallet trucks), cranes and hoists. Sorting and grading– advantages and methods.

Recommended Readings:

1. Singh, R. P., & Heldman, D. R (2014). *Introduction to Food Engineering* (5th ed.): Academic Press, New Delhi.
2. Saravacos, G. D., & Maroulis, Z. B. (2011). *Food Process Engineering Operations*: CRC Press, Boca raton.
3. Toledo, R.T. (2007). *Fundamentals of Food Process Engineering* (3rd ed.): Springer, New York.
4. Gustavo, V. B-C., & Ibarz, A. (2002). *Unit Operations in Food Engineering*: CRC Press.
5. Lozano, J. E (2000). *Trends in Food Engineering.*
6. Rao, D.G (2014). Fundamentals of Food Engineering: PHI Learning, Delhi
7. Heldman, R & Daryl, B (2007). Handbook of Food Engineering (2nd ed.): CRC Press

8. Smith, P.G (2011). Introduction to Food Process Engineering (2nd ed.): Springer, New York
9. Stavros Yanniotis (2008). Solving Problems In Food Engineering; Springer, New York

Course Outcomes:

1. Students shall be able to understand Basics of Mass & Energy Conservation as applied to Food Processing Operations.
2. Students shall be able to understand Basics of Fundamentals of Food Processing Operations.
3. Students shall be able to understand working of equipments in Food Industry related to transport of Fluids, Thermal Processing and Material Handling along with basics as applied to Food Processing Operations.
4. Students shall be able to understand Basics of Psychrometrics & Air Conditioning Processes related to Food Processing Operations.
5. Student shall be able to understand Basics of Mathematical Calculations related to above Engineering Applications as applied to Food Processing Operations.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	1	1	1
PO2	1	1	1	1	1
PO3	3	3	3	3	2
PO4	1	1	1	2	1
PO5	3	2	1	2	3
PO6	1	1	1	1	1
PO7	2	3	3	3	1
PO8	1	2	2	2	3
PO9	2	3	2	3	2

UC-MSFT-513- 19: FOOD MICROBIOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

To understand the role and significance of microbes of different categories, microbial inactivation and environmental factors that affect them in foods.

UNIT-I

Introduction to microbiology: Historical developments, Classification – A brief account, basis of classification. Three and five kingdom classification, Procaryotes and Eucaryotes. Microbial growth and nutrition. Introduction to food microbiology: Classification of microbes, Types of micro-organism normally associated with food- mold, yeast, and bacteria. Contamination of foods- vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.

UNIT-II

Factors affecting microbial growth: Intrinsic and extrinsic factors, Biochemical changes caused by micro-organisms, deterioration of various types of food product. Microbiology of food preservation, heating process, irradiation, low temperature storage, chemical preservatives, high-pressure processing, control of water activity.

UNIT-III

Fermented and microbial foods: Fermented milk and milk products, fermented fruits and vegetables, fermented meat and fish products, fermented beverages (beer, vinegar and wine), single cell protein.

UNIT-IV

Food microbiology and public health: food poisoning and microbial toxins, types of food poisonings. Bacterial agents of food borne illness. Non-bacterial agents of food borne illness- poisonous algae, fungi and food borne viruses. Microbial standards for different foods. HACCP and food safety, hurdle technology and its applications.

Recommended readings:

1. Frazier, W. C. and Weshoff, D. C. (2015). *Food Microbiology*: Tata McGraw Hill Publication, New Delhi.
2. Adam, M. R. & Moss, M. O. (2008). *Food Microbiology:* Royal Society of Chemistry, Cambridge.
3. James, M. J. (2005). *Modern Food Microbiology* (5th ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5th ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applicants.* Prentice Hall, New Jersey.
6. Frazier, W. C. & Westhoff, D. C. (1995). *Food Microbiology (*4th ed.). TMH, New Delhi

Course Outcomes:

1. Understand the principles involving food spoilage and preservation involving microorganisms and explain why microbiological quality control programmes are necessary in food production.
2. Ability to identify the characteristics of important pathogens and spoilage microorganisms in foods.

3. Understand the role and significance of intrinsic and extrinsic factors on growth of microorganisms in foods and differentiate which organisms would be likely to grow in a specific food product.
4. Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated killed or made harmless in foods and identify ways to control microorganisms in foods.

5. Describe the beneficial role of microorganisms in fermented foods and in food processing.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	2	3	3	3
PO2	1	1	1	1	1
PO3	1	1	2	1	2
PO4	3	2	2	1	1
PO5	1	2	1	1	1
PO6	3	3	3	3	3
PO7	2	2	2	2	1
PO8	2	1	2	3	1
PO9	2	2	2	2	2

UC-MSFT-514- 19: FOOD PROCESSING & PRESERVATION

Total Marks: 100	L	T	P
	4	0	0

Objective:

To impart knowledge on the causes of food spoilage and principles of different techniques used in processing and preservation of foods. To identify and select preservation methods appropriate for specific foods and to learn the effects of preservation methods on the quality of food.

UNIT-I

Scope and importance of food processing, Historical developments in food processing. Types of foods and causes of food spoilage. Heat preservation and processing: Heat penetration, heat resistance of microorganisms, thermal death curve, types of heat treatments and effects on foods. Canning of foods, cans and container types, spoilage of canned foods.

UNIT-II

Cold preservation and processing: Distinction between refrigeration and freezing. Refrigeration– introduction, components of refrigeration system and changes in food during refrigerated storage. Effect of low temperature on fresh food. Freezing- technological principles of freezing operations, freezing curves, freezing systems and methods, factors determining freezing rate, changes in food during freezing. Freeze drying– conventional drying vs freeze drying, equipments used and effects of freeze drying on food quality.

UNIT-III

Drying, Dehydration and concentration: Sun drying and solar dehydration, drying curves, drying methods and type of dryers. Food concentration- methods of concentration of fruit juices, liquid food concentrates, changes in food during dehydration and concentration. Water activity- role of water activity in food preservation. Intermediate moisture foods (IMF)- principle, characteristics, advantages and problems of IM foods.

UNIT-IV

Food Irradiation: Use of ionization radiations in food preservation, sources, units, effects, limitations, dose determination, safety and wholesomeness of irradiated foods, food irradiation techniques and recent applications of irradiation in food preservation.

Microwave processing: Properties, mechanism of heating, application of microwave in food processing and its effects on nutrients.

Preservatives: Uses and effects of class I and class II preservatives in foods.

Recommended readings:

1. Sivasankar, B. (2014). *Food processing and preservation:* Hall of India Pvt., New Delhi.
2. Fellows, P. J. (2009). *Food processing Technology: Principles and Practice:* Woodhead Publishing.
3. Brennan, J. G. (2006). *Food Processing Handbook:* Weinheim: Wiley-VCH.
4. Zeuthen, P. & Bogh- Sprensen, L. (2003). Food Preservation Techniques: CRC Press, Boca raton.
5. Vonloesecka, H. W. (1998). *Drying and Dehydration of Foods:* Allied, Bikaner.

Course Outcomes:

1. To impart knowledge on the causes of food spoilage.
2. To learn principles of different techniques used in processing and preservation of foods.
3. To identify and select preservation methods appropriate for specific foods.
4. To learn the effects of preservation methods on the quality of food.
5. To learn different permitted food additive used in food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	3	3	3	3	3
PO3	1	3	3	3	3
PO4	1	3	3	3	2
PO5	1	2	2	2	2
PO6	2	3	3	3	3
PO7	2	3	3	3	1
PO8	1	2	2	2	2
PO9	3	3	3	3	3

UC-MSFT-515- 19: LAB - I (FOOD MICROBIOLOGY)

Total Marks: 50	L	T	P
	0	0	4

Objective:

To understand the microbial techniques and to develop skills related to microbial quality evaluation of foods using various techniques.

List of experiments:

1) Introduction to microbiological techniques:
    a. Requirements of a microbiology lab,
    b. Safety rules to be followed in the lab,
    c. Cleaning and sterilization techniques,
    d. Preparation of different types of growth media.
2) Bright field microscopy and examination of living micro-organisms,
3) Direct microscopic count of micro-organisms– use of Neubauer counting chamber.
4) Staining techniques:
    a. Simple staining,
    b. Gram staining,
    c. Spore staining and
    d. Negative staining etc.,
5) Culture techniques-
    a. Aseptic technique,
    b. Dilution technique.
6) Isolation of bacteria by
    a. Serial dilution (streak plate),
    b. Pour plating and spreading,
    c. Bacterial population count- standard plate count.
7) Microbiology of food:
    a. Microbiological analysis of food products-
        i. Bacterial count,
        ii. Yeast and mold count,
        iii. Coliform count,
        iv. Standard plate count of milk and direct microscopic count of milk,
        v. Reductase Test (MBRT).
    b. Microbiological testing of water-
        i. Quantitative test,
        ii. Bacteriological quality testing (MPN).

Course Outcomes:

1. Acquire the practical skills for the sampling of foods to carry out microbial analysis.
2. Ability to carry out various sterilization techniques and to identify the most suitable technique for specific food.
3. Ability to isolate and identify common food borne microbial pathogens.
4. Understand microbiological analysis methods for food products and ability to analyze different foods for presence of hazardous microorganisms using food microbiology technology.
5. Ability to interpret microbiological analysis of food products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	1	1	1	1	1
PO3	2	1	1	3	1
PO4	1	1	1	1	1
PO5	1	3	2	2	3
PO6	3	3	3	3	3
PO7	1	1	2	1	1
PO8	1	1	1	1	1
PO9	2	2	2	2	2

UC-MSFT-516- 19: LAB - II (FOOD PRESERVATION & ANALYSIS)

Total Marks: 50	L	T	P
	0	0	4

Objective:

To understand the effect of various preservation techniques on the quality and safety of food products. To design and evaluate a processing procedure used to preserve a food product.

List of experiments:

1. Sampling techniques and preparation of test samples,
2. Estimation of Water activity of food sample.
3. Physical and Chemical evaluation of thermally processed food (Canned or Bottled),
4. Test for adequacy of Blanching, pasteurization and sterilization.
5. In-bottle pasteurization and sterilization of fruit juices,
6. Standardization of the procedure for thawing of frozen food,
7. Pickling and curing of foods,
8. Determination of sodium chloride in brine,
9. Determination of moisture content in fresh and dried food samples,
10. Effect of pH on microbial stability of food,
11. Dehydration of foods
12. Preparation of fruit juice concentrates and powder,
13. Physicochemical analysis of dehydrated food sample,
14. Use of chemical preservatives in food,
15. Estimation of crude fat in pickle samples.
16. Estimation of amount of preservatives in processed food sample,
17. Determination of total minerals of fruit pulp.
18. Freeze drying of food sample by Lyophilizer.
19. Freezing point determination by freezing point apparatus.

Course Outcomes:

1. To understand the sampling techniques and preparation of test samples.
2. To understand the effect of various preservation techniques on the quality and safety of food products.
3. To design and evaluate a processing procedure used to preserve a food product.
4. To understand the physical and chemical evaluation of thermally processed food.
5. To understand and utilize different food preservation techniques.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	3	3	3	3	3
PO3	3	3	3	3	3
PO4	3	3	2	2	2
PO5	3	3	3	3	3
PO6	1	3	3	3	3
PO7	2	3	3	3	3
PO8	3	3	3	3	3
PO9	3	3	3	3	3

UC-MSFT-517- 19: NUTRACEUTICAL & FUNCTIONAL FOODS

Total Marks: 100	L	T	P
	4	0	0

Objective:

To teach basic understanding of the concepts of nutraceuticals and functional foods and their use for managing chronic diseases.

UNIT-I

Nutraceutical
Historical perspective, definition, Nature, Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions, Scope and Future prospects. Applied aspects of the Nutraceutical Science, Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition.

Functional Food
Overview, Definition, Classification Functional Food, functional Food science, Food technology and its impact on functional food development, Markers for development of functional foods, Key issues in Indian functional food industry & nutraceutical.

Antioxidant
Concept of free radicals and antioxidants, Antioxidants role as nutraceuticals and functional foods.

UNIT-II

Food as remedies
Nutraceuticals bridging the gap between food and drug; Nutraceuticals for specific situations such as cancer, heart disease, Diabetics, stress, osteoarthritis, hypertension.

Food sources
Different food as functional food: Cereal products (oats, wheat bran, rice bran etc.), fruits & vegetables, milk and milk products

UNIT-III

Food sources
Legumes, nuts, oil seeds and sea foods, herbs, spices and medicinal plant. Coffee, tea and other beverages as functional foods/drinks and their protective effects

Properties and functions of various Nutraceuticals / Functional Food Ingredients
Protein, Complex carbohydrates like Dietary fibers as functional food ingredients, Probiotic, prebiotics & symbiotic foods and their functional role. Properties and functions of various polyphenols.

UNIT-IV

Anti-nutritional Factors present in Foods:
Types of inhibitors present in various foods and their inactivated. Assessment of nutritional status and Recommended Daily allowances.

Effects of processing, storage and interactions of various environmental factors on the potentials of such foods

Marketing and regulatory issues for functional foods and nutraceuticals. Recent development and advances in the areas of nutraceutical and functional foods.

References Books:

1. Functional Foods: Biochemical and Processing Aspects, Volume 1; Giuseppe Mazza; CRC Press
2. Handbook of Nutraceuticals and Functional Foods, Second Edition; Robert E.C. Wildman; CRC Press
3. Dietary Supplements of Plant Origin; Massimo Maffei; CRC Press
4. Nutraceutical beverages Chemistry, Nutrition and health Effects; Fereidoon Sahidi, Deepthi K. Weerasinghe; American Chemical Society
5. Vegetables, fruits, and herbs in health promotion Ronald R. Watson; CRC Press
6. Fruit and Cereal Bioactives: Sources, Chemistry, and Applications; Özlem Tokusoglu; Clifford Hall III; CRC Press
7. Handbook of Dietary Fibre Susan Sungsoo Cho, Mark L. Dreher; Marcel Dekker

Course Outcomes:

1. To understand the concept of nutraceuticals and functional foods towards managing chronic diseases.
2. To understand the source of various nutraceuticals and functional foods.
3. to understand the role of various nutraceuticals and functional foods towards managing chronic diseases.
4. Describe a healthy diet and food choices, and explain why such choices will help prevent health problems.
5. To learn the marketing and regulatory aspects of nutraceuticals and functional foods.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	2
PO2	3	3	3	3	1
PO3	3	2	3	2	3
PO4	3	2	3	2	3
PO5	2	2	2	2	1
PO6	3	2	3	2	2
PO7	3	3	3	3	2
PO8	2	2	2	2	2
PO9	3	3	3	3	3

SEMESTER

SECOND

UC-MSFT–521- 19: DAIRY TECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

To impart knowledge about processing of milk and its products and legislation for the quality control of milk and milk products.

UNIT-I

Dairy industry in India: scope, strengths and opportunities for dairy industry.

Definition, composition and nutritive value of milk, Environmental and biological factors affecting composition of milk. Physicochemical properties of milk. Milk lipids: chemical properties, structure, fat destabilization, functional properties. Milk proteins: types, protein precipitation (casein micellar structure and its aggregation). Milk enzymes, enzymatic and acid coagulation of milk.

UNIT-II

Storage and processing of fluid milk: pasteurization, sterilization, homogenization, UHT processing and aseptic packaging.

Membrane processing of milk: types of membranes, principle of operation, applications of reverse osmosis, ultrafiltration and microfiltration.

Technology of condensed and evaporated milk: composition, nutritive value, process of manufacture, defects - their causes and prevention.

Technology of milk powders (WMP, SMP): composition, nutritive value, process of manufacture, defects - their causes and prevention, Instantization of milk powder.

UNIT-III

Technology of Milk products: Cheese- classification, composition, nutritive value, process of manufacture of cheddar, mozzarella, cottage and processed cheese, defects - their causes and prevention.

Frozen milk products- composition, nutritive value, process of manufacture, defects (their causes and prevention).

Indigenous milk products - dahi, butter, ghee, channa, paneer etc. Utilization of milk industry by-products- importance/need and food applications.

UNIT-IV

Milk and milk products standards and legislations in India, Grading of milk and criterion of grading.

Dairy plant sanitation- hygiene in dairy industry, different types of cleansing and sanitizing agents, their applications, cleaning systems (cleaning in place, central cleaning system, self-contained cleaning system).

Newer concepts in dairy products- cream powder, sterilized cream, butter spread, butter powder, cheese spread, caseinates, co-precipitates, WPC, lactose powder.

Recommended readings:

1. Sukumar, De. (1980). *Outlines of Dairy Technology:* Oxford University Press, Delhi.
2. Byron, H. W., Arnold, H. J. & John, A. A. (1987). *Fundamentals of Dairy Chemistry* (2nd ed.): CBS, Delhi.
3. Atherton, H. V. & Newlander, J. A. (1987). *Chemistry and Testing of Dairy Products* (4th ed.): CBS, New Delhi.
4. Wong, N. P. (1988). Fundamentals of Dairy Chemistry (3rd ed.): VNR, New York.
5. Cheke, V. & Sheepard, A. (1997). Cheese and Buller: Allied, Bikaner.

Course Outcomes:

Students shall acquire knowledge about

1. Composition of milk and milk products.
2. Processing of milk and milk products.
3. Different milk product development.
4. Organization and operations involved in milk processing unit.
5. To understand legislation for the quality control of milk and milk products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	2
PO2	3	3	3	2	1
PO3	3	3	3	3	3
PO4	3	3	3	2	3
PO5	2	2	2	1	1
PO6	3	3	3	3	2
PO7	3	3	3	2	2
PO8	2	2	3	3	2
PO9	3	3	3	3	3

UC-MSFT-522- 19: TECHNOLOGY OF FRUITS AND VEGETABLES

Total Marks: 100	L	T	P
	4	0	0

Objective:

To develop knowledge regarding biochemistry and physiology of fruits and vegetables and their role in pre- and post-harvest changes in product quality.

UNIT-I

Current status of fruits and vegetables processing, classification and composition of fruits and vegetables and their nutritional significance. Pre-harvest factors influencing post-harvest physiology, post-harvest handling and precooling methods, post-harvest treatments, edible coatings, cold chain, and commercial cooling systems.

UNIT-II

Physical and chemical indices of fruit maturity, crop maturity and ripening. Biochemical changes during maturation, ripening, processing and storage.

Methods of storage: refrigerated, controlled atmosphere and hypobaric storage. Modified atmosphere packaging- role of gases, and influence of MAP on microorganisms, advantages and disadvantages.

Pre-processing operations- washing, blanching, peeling, sorting and grading of raw materials. Minimal processing of fruits and vegetables, quality factors for processing, fruit product order (FPO).

UNIT-III

Technology of production of jam, jellies and marmalades, specifications, role of pectin and theories of gel formation. Preparation of fruit juices, concentrates, fruit juice powders, specifications and packaging. Technology of juice extraction and clarification, tomato products, preserved and candied fruits, dehydrated fruits. Spoilage of processed products. Canning of fruits and vegetables, preparation of syrups and brines, can reforming and can seaming.

UNIT-IV

Stages of new product development, by-products from fruit and vegetable wastes, utilization and disposal of fruit industry wastes. Technology of mushroom: production, processing and its processed products. Technology of cashew and coconut: chemical composition, processing and processed products.

Recommended Readings:

1. Jongen, W. (2002). *Fruit and vegetable processing: Improving Quality:* Woodhead Publishing, Boca raton.
2. Thompson, A. K. (1996). *Post-harvest Technology of Fruit and Vegetables:* Blackwell, Australia.
3. Thompson, A. K. (2003). *Fruits and Vegetables- Harvesting, Handling and Storage:* Blackwell, Oxford.
4. Verma, L. R. & Joshi, V. K. (2000). *Post-harvest Technology of Fruits and Vegetables:* Indus, New Delhi.
5. Srivastava, R. P. & Kumar, S. (2001). *Fruit and Vegetable Preservation– Principles and Practices (3 ed.):* International Book distributing Co., Lucknow (India).

Course Outcomes:

1. The students shall be able to understand Biological, Chemical & Physical Properties of Fruits & Vegetables.
2. The students shall be able to understand Technologies involved in Processing, Preservation & Value- Addition of Fruits & Vegetables.
3. Students shall be able to understand Industrial Processes for Commercial Production of Jams, Jellies, Marmalade, Fruit Juices, Concentutes, Fruit Juice Powder, Dehydrated Fruits, and Canning of Fruits & Vegetables.
4. Students shall be able to understand Basics of New Food Products Development & Ideas Generation for Product Development.
5. Students shall be able to understand Basics of By Product Utilization & Waste Utilization related to Fruits & Vegetables.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	2	1	1	1	1
PO3	1	2	2	2	2
PO4	1	3	1	3	1
PO5	1	2	1	1	1
PO6	1	2	3	1	1
PO7	2	1	3	2	3
PO8	1	1	1	1	1
PO9	3	1	1	3	1

UC-MSFT-523- 19: PACKAGING TECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

The course aims to develop the student's knowledge in packaging of foods.

UNIT-I

Introduction to food packaging: definition, factors involved in the evolution and selection of a food package, functions of food packaging. Paper and paper based packaging materials: types of paper (Kraft, bleached, greaseproof, glassine), paper products (paper bags, cartons, drums and moulded paper containers), and functional properties of paper. Testing of paper packaging materials. Plastic packaging materials: classification of polymers. Thermoplastic polymers- functional and mechanical properties, processing and conversion of thermoplastic polymers (extrusion, blow moulding, injection moulding, compression moulding, lamination and heat sealing). Testing of plastic packages.

UNIT-II

Metal packaging materials: container making processes (end manufacture, three-piece can manufacture and protective and decorative coatings), functional properties of metal containers and quality control tests of tin plate containers. Glass packaging materials: composition, manufacturing and nomenclature of glass containers. Glass containers- closure functions, closure terminology and construction. Properties of glass containers– mechanical, thermal and optical properties. Testing of glass containers.

UNIT-III

Aseptic packaging of foods: sterilization of packaging material, food contact surfaces and aseptic packaging systems. Active food packaging: definition, scope, physical and chemical principles. Edible films and coatings: use of edible active layers to control water vapour transfer and gas exchange, modification of surface conditions with edible active layers. Oxygen absorbents: classification and types of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf-life extension of food and their advantages and disadvantages.

UNIT-IV

Ethanol vapour: ethanol vapour generator, uses of ethicap for shelf-life extension of food, effect of ethanol vapour on food spoilage/food poisoning bacteria, advantages and disadvantages of ethanol vapour generators. Safety considerations in food packaging: types of food safety problems associated with package, package labelling and food safety.

Packaging requirements of selected foods: cereal and snack food, beverages, milk and dairy products, poultry and eggs, red meat, frozen foods, horticultural products and microwavable foods.

Recommended readings:

1. Rooney, M.L. (1995). *Active Food Packaging*: Blackie Academic & Professional, Glasgow, UK.
2. Coles, R. & Kirwan, M. (2011). *Food and Beverage Packaging Technology* (2nd ed.): Wiley-Blackwell, UK.
3. Eiri Board of Consultants. (2007). *Food Packaging Technology:* Engineers India Research Institute, New Delhi.

4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2nd ed.)*:* CRC Press, Boca raton.
5. Piringer, O. P. & Baner, A. L. (2000). *Plastic Packaging Materials for Food:* Wiley-VCH, Weinheim.

Course Outcomes:

Students shall gain knowledge on

1. The different types of materials and media used for packaging foods.
2. Manufacturing processes for different packaging materials.
3. Quality testing techniques for different packaging materials.
4. Hazards and toxicity associated with packaging materials.
5. Laws, regulation and the monitoring agencies involved in food safety.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	3	3	3	3	3
PO3	3	3	3	2	3
PO4	3	3	3	3	3
PO5	1	3	3	3	3
PO6	3	3	3	3	3
PO7	3	3	3	3	3
PO8	2	3	3	3	3
PO9	3	3	3	3	3

UC-MSFT-524- 19: LAB - III (DAIRY TECHNOLOGY)

Total Marks: 50	L	T	P
	0	0	4

Objective:

Imparting knowledge about the general methods of quality evaluation, testing and processing fresh milk and milk products.

List of experiments:

1. Sampling of milk and milk products,
2. Platform tests of milk:
    a. Organoleptic test,
    b. Sediment test,
    c. COB test,
    d. Alcohol test,
    e. Alcohol-Alizarin test,
    f. Titratable acidity and
    g. pH milk.
3. Determination of specific gravity of milk,
4. Total solids and solid-not-fat using lactometer,
5. Detection of milk adulterant-
    a. Added water,
    b. Starch,
    c. Cane sugar,
    d. Neutralizers and
    e. Preservatives (formalin and hydrogen peroxide),
    f. Synthetic milk (urea test, detergent test, common salt),
6. Alkaline phosphatase test to determine adequacy of pasteurization.
7. Estimation of casein in milk, lactose, chlorides, Reichert-Meissel number and Polensky value,
8. Moisture in butter (Dean and Stark distillation),
9. Colouring matter in butter,
10. Curd and salt in butter,
11. Peroxide value, Iodine value of ghee,
12. Acid value of ghee,
13. Saponification value of ghee,
14. Fat in cream
15. Total solids in cream.
16. Development of some indigenous dairy products-
    a. Standardization and preparation of khoa/ice cream/ rasogulla.

Course Outcomes:

Student shall acquire knowledge about

1. How to do sampling of milk and milk products.
2. Physical, Chemical & Microbial analysis of milk and milk products.
3. Development of different milk products.
4. Characterization of milk products.
5. Quality control of milk & milk products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	3
PO2	1	2	1	1	2
PO3	3	1	1	3	1
PO4	2	1	2	1	1
PO5	1	2	1	2	1
PO6	1	1	2	3	1
PO7	3	2	1	1	2
PO8	2	3	3	2	1
PO9	1	1	3	2	1

UC-MSFT-525- 19: LAB - IV (TECHNOLOGY OF FRUITS AND VEGETABLES)

Total Marks: 50

L	T	P
0	0	4

Objective:

To equip students with skills required for preparation and evaluation of jam, jelly, marmalade, pickles, sauces and preserves.

List of experiments:

1. Determination of maturity indices for fruits.
2. Colour measurement of fruits and vegetables/products by disc colorimetry/tintometer.
3. Preparation of jam, cheese, preserved and candy, jelly and testing of jelly grade.
4. Preparation of fruit juice products, Squash, Nectar/cordial, fruit bar, murabba, tomato puree, paste, sauce.
5. Enzyme extraction and clarification of fruit pulp/juice.
6. Dehydration of fruits,
7. Thermal processing of fruits/fruit products.
8. Adequacy of pasteurization/ sterilization/blanching.
9. Proximate analysis of fruits and their products-
    a. Estimation of TSS,
    b. moisture,
    c. total solids,
    d. titratable acidity,
    e. ascorbic acid,
    f. total and reducing sugars ,
    g. non-enzymatic browning,
    h. pectin,
    i. total polyphenolic compounds,
    j. tannin,
    k. total carotenoids.
10. Determination of enzymatic activity in ripe fruit sample.
11. Estimation of minerals in fruits by spectrophotometery, flame photometery/AAS.

Course Outcomes:

1. Ability to assess the quality of fruit and vegetables.
2. Ability to establish the quality specifications for the processing of fruit and vegetables.
3. Ability to develop various fruit and vegetable products with quality assurance and safety.
4. Understand principles and methods of preservation of fruits and vegetables.
5. To develop proficiency skill in preserving fruits and vegetables into various products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	2	3	3
PO2	1	3	2	2	2
PO3	1	3	3	3	2
PO4	3	2	1	2	3
PO5	1	3	2	2	2
PO6	1	3	3	3	3
PO7	3	3	1	3	3
PO8	1	2	1	2	2
PO9	2	3	3	3	3

UC-MSFT-526- 19: LAB – V (PACKAGING TECHNOLOGY)

Total Marks: 50

L	T	P
0	0	4

Objective:

The course aims to develop the practical knowledge of testing of package, package material and packaging of foods.

List of experiments:

1. Identification and testing of packaging materials,
2. Determination of wax from wax paper;
3. Testing of lacquered tin plate sheets;
4. Determination of equilibrium moisture content;
5. Determination of water vapour transmission rate of packaging material;
6. Determination of Gas transmission rate of packaging material;
7. Determination of COB value of Paper and CFB
8. Determination of Burst strength of the boxes,
9. Testing the compression strength of the boxes;
10. Scuf Proffness Test,
11. To perform vacuum packaging of food sample and carry out its storage study;
12. Packaging the food material in seal and shrink packaging machine and study its shelf life;
13. Testing the strength of glass containers by thermal shock test;
14. Testing the strength of filled pouches by drop tester,
15. Head Space Gas Analysis Laboratory/ Practical.
16. Preparation sorption isotherm curve and estimation of shelf life various packaged foods.

Course Outcomes:

Students shall gain knowledge

1. To identify different types of materials and media used for packaging foods.
2. Quality testing techniques for different packaging materials.
3. Novel packaging used in food industry.
4. Laws and regulation related to labelling of food product.
5. Application of different packing materials for food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	3	3	3	3	3
PO3	3	3	3	3	3
PO4	3	3	3	3	3
PO5	3	3	2	3	3
PO6	3	3	3	3	3
PO7	3	3	3	3	3
PO8	3	3	2	3	3
PO9	3	3	3	3	3

ELECTIVE-I

UC-MSFT-527- 19: BIOPROCESS TECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

Acquaintance with importance of food fermentation and its application in food sector.

UNIT-I

Overview of fermentation: fermentation as an ancient art, modern era of fermentation technology. Biology of industrial micro-organisms- isolation, screening and genetic improvement of industrially important micro-organisms.

UNIT-II

Fermentation systems: batch and continuous systems, fed-batch culture, feedback systems, fermenter design, solid substrate fermentation, Instrumentation and control. Fermentation raw materials- criteria used in media formulation, influence of medium, raw materials for process control.

UNIT-III

Downstream processing: objectives, steps, problems, separation processes. Microbial production of various primary and secondary metabolites- alcohol, amino-acids , organic acids (citric acid and acetic acid), enzymes, antibiotics (penicillin, cephalosphorin). Principles of overproduction of metabolites.

UNIT-IV

Biomass production: microbial production of single cell protein, Baker's yeast. Immobilized enzyme technology- methods of immobilization and applications. Membrane technology- methods and applications in bioprocessing. Waste treatment- introduction, waste treatment systems, microbial inoculants and enzymes for waste treatments.

Recommended readings:

1. Crueger, W. & Crueger, A. (2000). *Biotechnology: A Textbook of Industrial Microbiology* (2nd ed.)*:* Panima, New Delhi.
2. Rehm, H. J., Red, G. (1993). *Biotechnology: A Multi Volume Comprehensive Treatise* (2nd ed.): VCH, New York.
3. Stansbury, P. F., Whitakar, A. and Hall, S. J. (1997). *Principles of Fermentation Technology* (2nd ed.): Pergamen Press, Oxford.
4. Reed, G. (1987). *Prescott & Dunn's Industrial Microbiology* (4th ed.): CBS, New Delhi.
5. Mansi, E. M. T. E. L. & Bryce, C. F. A. (1999). *Fermentation Microbiology and Biotechnology:* Taylor and Francis, London.

Course Outcomes:

At the completion of the program the student will:

1. Appreciate the positive role and benefits of microorganisms and enzymes in food production, processing, and preservation.
2. Understand basic biological and chemical processes of living cells, enzymes, and microbial nutrition in relation to fermentation processes.
3. Understand principles of inoculum /starter culture development for industrial fermentations and fermenter /reactor design, control and operation.

4. Understand both upstream and downstream unit operations and technologies used for substrate preparation and recovery and purification of fermentation products.
5. Discuss and evaluate the operational considerations and relative advantages relating to the choice of techniques used in downstream processing of food products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	3	1	1	1
PO2	2	3	1	1	1
PO3	1	2	1	2	1
PO4	1	1	1	3	3
PO5	2	1	2	1	1
PO6	3	2	3	1	1
PO7	3	3	1	1	2
PO8	1	2	1	3	2
PO9	2	1	1	1	1

UC-MSFT-528- 19: TECHNOLOGY OF BEVERAGES

Total Marks: 100	L	T	P
	4	0	0

Objective:

To provide an understanding of the science and technology for processing different types of beverages.

UNIT-I

Beverages, importance of beverages in our diet, treatment of water for food industry. Technology of alcoholic and non-alcoholic beverages- wine, cider, brandy, perry, toddy. Fruit juice beverages- methods of production, preservation and packaging, physiological aspects of fruit juice production and methods of fruit juice clarification.

UNIT-II

Technology of soft drinks, mineral water, ingredients, and additives used in production of soft drinks. Manufacturing of carbonated and non-carbonated beverages, technology of carbonation, and application of CO_2 in juice preservation.

UNIT-III

Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low calorie sweeteners in beverages.
Equipments and machineries for juice pressing, methods of bottling, enzymatic clarification and debittering of juices. Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.

UNIT-IV

Production, processing and chemistry of tea manufacturing, tea products such as soluble tea, tea concentrate, de-caffeinated and flavoured tea. Production, processing, roasting and brewing of coffee, soluble coffee manufacture, standards and specifications of coffee products, de-caffeinated coffee, and coffee brew concentrate and chicory. Cocoa processing and cocoa beverages.

Recommended Readings:

1. Rao, L. J. M. & Ramalakshmi, K. (2011). *Recent trends in soft beverages:* AFST, India.
2. Priest, F. G. & Campbell, I. (1996). *Brewing Microbiology* (2nd ed.): Chapman and Hall, London.
3. Hui, Y. H. (2004). *Handbook of Food and Beverage Fermentation Technology:* Marcel Dekker, New York.
4. Varnam, A. H. & Sutherland, J. P. (1994). *Beverages: Technology, Chemistry and Microbiology:* Chapman, London.
5. Varnam, A. H. & Sutherland, J. P. (2009). *Beverages Technology, Chemistry and Microbiology:* Springer, UK.

Course Outcomes:

1. Ability to understand the science and technology for processing different types of beverages.
2. Ability to explain processing of fruit juice beverages, carbonated beverages, citrus beverages, tea and coffee.
3. Understanding of permitted additives in beverages.
4. Ability to understand the impact of processing on quality of beverage.

5. Knowledge of recent high value added beverages and recent trends in beverage industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	3	3	2
PO2	3	2	3	3	2
PO3	3	3	1	2	3
PO4	2	2	2	1	3
PO5	1	1	1	1	1
PO6	2	2	3	3	3
PO7	3	3	1	3	3
PO8	1	1	2	1	2
PO9	2	2	2	2	2

UC-MSFT-529- 19: LAB – VI (BIOPROCESS TECHNOLOGY)

Total Marks: 50	L	T	P
	0	0	4

Objective:

To educate students about industrial production of fermented foods and their analytical techniques.

List of experiments:

1. Isolation of yeast from natural sources,
2. Isolation of lactic acid bacteria from different sources,
3. Amylase/lipase/protease production from soil/samples.
4. Production of
    - **a.** Industrial alcohol,
    - **b.** Grape wine (Red wine/ white wine),
    - **c.** lactic acid,
    - **d.** Yoghurt,
    - **e.** Acidophilus milk,
    - **f.** Sauerkraut.
5. Analytical assays in fermentation:
    - **a.** Estimation of ethanol, lactic acid, total acids.
6. Determination of cell mass.
7. Analysis of COD in Distillery/Food industry effluent sample.
8. Estimation of Hardness of water/ Bottled water/Potable water samples.
9. Evaluation of antimicrobial activity/ efficacy of various sanitizers/ Disinfectants and preservatives.

Course Outcomes:

At the completion of the program the student will:

1. Understand the various concepts of fermentation.
2. Isolate and identify microorganisms from fermenting fruits, cereals and milk;produce some drinks and foods e.g. bread, beer, wine and vinegar resulting from alcoholic fermentation.
3. Produce some foods and drinks e.g. yoghurt resulting from acidic fermentation.
4. Experience in functioning within a team.
5. Understand principles underlying Quality Assurance.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	1	1	1	3
PO2	3	1	3	1	2
PO3	1	3	1	2	1
PO4	1	1	1	3	1
PO5	1	1	2	1	1
PO6	1	1	1	1	2
PO7	2	2	3	2	1
PO8	1	1	1	1	1
PO9	1	1	1	3	1

UC-MSFT-530- 19: LAB - VII (TECHNOLOGY OF BEVERAGES)

Total Marks: 50

L	T	P
0	0	4

Objective:

To educate students various laboratory techniques for analysing and measuring the important physicochemical parameters of beverages.

List of experiments:

1. Determination of water quality parameters for beverages,
2. Preservation and packaging of alcoholic and non-alcoholic beverages,
3. Determination of quality parameters for alcoholic and non-alcoholic beverages,
4. Standardization of method for fruit juice extraction and clarification, enzymatic clarification, process optimization of fruit juice beverages,
5. Effect of carbonation on shelf life of fruit beverages,
6. Extraction and dibittering of citrus juice,
7. Evaluation of quality testing parameters of wines,
8. Chemical and sensory quality analysis of soft drink,
9. Preparation of whey based beverages.
10. Decaffeination and sensory evaluation of coffee beverages:
    a. Process optimization and sensory evaluation of cocoa beverages,
11. Determination of brewing quality parameters of tea and coffee.

Course Outcomes:

1. Ability to use laboratory techniques to analyze and measure important physicochemical parameters of beverages.
2. Ability to assess various quality parameters of beverages including sensory evaluation.
3. Ability to understand regulatory requirements regarding quality of water for beverages.
4. Ability to acquire skill for development of high value added tea and coffee beverages.
5. Ability to acquire skill for standardization of methods for developing beverages.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	3	3	3	3
PO2	2	2	2	2	2
PO3	2	1	1	3	3
PO4	1	3	2	3	3
PO5	3	2	1	1	1
PO6	1	3	3	2	3
PO7	3	1	1	3	1
PO8	1	1	2	1	2
PO9	3	3	3	2	3

SEMESTER

THIRD

UC-MSFT-611- 19: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Total Marks: 100	L	T	P
	4	0	0

Objective:

To create knowledge about the processing and quality evaluation of cereal grains.

UNIT-I

Current status and future scenario of world wheat production and uses. Criteria of wheat quality– physical and chemical. Chemical composition of wheat grain and its relation to processing quality. Molecular basis of wheat grain hardness/softness. Wheat milling – general principle, cleaning, conditioning and milling systems. Flour streams, extraction rates and their composition. Criteria of flour quality. Functionality of wheat proteins, carbohydrates and lipids in bakery products. Manufacturing techniques, uses and functionality of vital wheat gluten. Enzymes of wheat and their technological significance.

UNIT-II

Dough rheology and dough testing apparatus such as recording dough mixers. Bread making processes, importance of critical unit operations, development in bread making methods, functions of ingredients/additives such as fat, emulsifiers, oxidants, reducing agents, conditioners. Bread faults and remedies. Technology of biscuit, cake, cookie and cracker manufacture. Functions of ingredients in soft wheat products. Durum wheat- chemistry, quality and technology of pasta products.

UNIT-III

Rice grain structure and chemical composition. Milling of rice- types of rice mill (huller mill, sheller-cum-huller mill, sheller-cum-cone polisher mill, small capacity rice mill). Modern rice milling unit operations – dehusking, paddy separation, polishing and grading. Factors affecting rice yield during milling. Control and assessment of degree of milling. By- products of rice milling and their utilization. Cooking quality of rice. Parboiling of rice- traditional methods and their drawbacks. CFTRI process of parboiling. Properties of parboiled rice. Changes during parboiling. Advantages and disadvantages of parboiling. Rice convenience foods- precooked rice, canned rice, expanded rice, rice based infant food formulas, rice puddings and breads, rice cakes, rice noodles and fermented foods.

UNIT-IV

Chemical, technological and nutritional aspects of sorghum, oats and millets. Coarse grain based processed foods. Wet and dry milling of corn. Corn products and their uses. Malting of barley-steeping, germination and drying. Classification of malt products, nutritive value and food applications of malt. Pluses: composition and importance in Indian diet. Dal milling and processing of pulses. Oilseeds: Conditioning and oil extraction, significance of oil seeds processing in India, expeller pressing and solvent extraction of oil, oil refining, preparation of protein concentrate, isolates and their use in high protein foods.

Recommended readings:

1. Khatkar, B.S. (2010). Baking Science and Technology. Arihant Prakashan Pvt Ltd., New Delhi.
2. Samuel, A.M. (2014). *The Chemistry and Technology of Cereals as Food and Feed:* CBS Publication, New Delhi.
3. Khan, K. & Shewry, P. R. (2009). *Wheat: Chemistry and Technology:* St. Paul, U.S.A.
4. Champagne, E.T. (2004). *Rice: Chemistry and Technology*(3rd ed.): *AACC, USA.*

5. Dendy, D. A. V. & Dobraszczyk, B. J. (2001). *Cereals and Cereal Products: Chemistry and Technology:* Aspen, Maryland.
6. Pomeranz, Y. (1998). *Wheat: Chemistry and Technology (3rd ed.):* AACC, USA.

Course Outcomes:

1. Student will acquire the understanding of the technology for Wheat Milling & Wheat based Food Products.
2. Student will acquire the understanding of the technology for Rice Milling & Rice based other Food Products.
3. Student will acquire the understanding of working of equipments related to Wheat & Rice Milling along with equipments related to Wheat based & Rice based Food Products.
4. Student will be able to understand technology for Milling of Corn & Corn based other Food Products along with equipments.
5. Student will be able to understand technology for Oil Extraction & Oil Seed Processing along with equipments.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	2	3	3
PO2	3	3	2	3	3
PO3	3	3	3	3	3
PO4	3	3	3	3	3
PO5	1	1	1	1	1
PO6	1	1	1	1	1
PO7	3	3	3	3	3
PO8	2	2	2	2	2
PO9	3	3	3	3	3

UC-MSFT–612- 19: FOOD SAFETY, STANDARDS AND QUALITY CONTROL

Total Marks: 100	L	T	P
	4	0	0

Objective:

To create understanding of quality control and assurance, risk assessments, GMPs, and regulations in the food sector.

UNIT-I

Definition, objective, scope and functions of food safety and quality assurance, Quality enhancement models, Statistical Quality Control for food industry, Quality control tools, Quality control charts for food plant sanitation, Food Safety Management Systems, Causes of failure of Food Safety Programs, Introduction of Food Quality Management Systems, Production planning and Control.

UNIT-II

WTO, FAO, WHO, Codex Allimentarius Commission, GMP, GHP, Cleaning and disinfection Principles. Implementation of quality control programmes, HACCP, ISO – 22000 series, Introduction to USFDA & BRC.

UNIT-III

ISO–9000 series, Concept of total quality control (TQM), GLP, ISO-17025. Intellectual Property: concept and fundamental- Patent Laws, copy right, trade mark and IPR. Sampling and labeling requirements for different Food products, Introduction to BIS, AGMARK, Organic food, Functions of EIC in export of food product.

UNIT-IV

Sensory evaluation: Introduction, panel screening, selection methods, interaction and thresholds. Food adulteration: Types of adulterants, Common adulterants for foods like milk and milk products, honey, wheat flours, edible oils, cereals, condiments (whole and ground) pulses, coffee, tea, confectionery, baking powder, non-alcoholic beverages, vinegar, besan and curry powder

Recommended readings:

1. Singh, S. P. (2009). *Food Safety, Quality Assurance and Global Trade: Concerns and Strategies:* International Book Distributing Co. Lucknow.
2. Metha, R. & George, J. (2005). *Food Safety regulation concerns and trade: A Developing Country Perspective.*
3. Pomeranz, Y. & Meloan, R. (1995). *Food Analysis: Theory and Practice:* AVI Publication, New York.
4. Askar, A. & Treptow, H. (1993). *Quality assurance in Tropical Fruit Processing.*
5. Mahindru, S. N. (2000). *Food Safety: A Techno-legal Analysis:* Tata Mc, India.

Course Outcomes:

1. To create understanding of quality control and assurance system in food industry.
2. To understand the risk assessments procedure for food sector.

3. GMPs and GHP regulations in the food sector.
4. To understand the different food safety management used worldwide.
5. To understand the sensory evaluation methodology used in food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	2	3	2	2	3
PO3	3	3	3	3	3
PO4	3	3	3	3	3
PO5	2	2	2	2	3
PO6	3	3	3	3	3
PO7	2	3	2	2	3
PO8	2	2	2	2	3
PO9	3	3	3	3	3

UC-MSFT- 613- 19: AGRI BUSINESS MANAGEMENT

Total Marks: 50 L T P

2 0 0

Objective:

To impart knowledge related to market types, the procurement, marketing and management of raw and processed agricultural produce meant for human consumption.

UNIT-I

Introduction, definition, history, objectives, importance with respect to Indian economy and globalization. Agricultural and food policy, rural management. Management of agri-business. New product development: introduction, development and value analysis.

UNIT-II

Entrepreneurship Development Programs (EDP): introduction, importance, characteristics and functions of an entrepreneur, SWOT analysis of new industries and products. Government schemes and incentives for promotion of entrepreneurship. Financing and risk management in agri-business.

UNIT-III

Marketing management: role of management in agri-business, attributes and responsibility of manager. Marketing of agricultural produce. Market research for agri-business. Different types of management in agri-business: production, retail and supply chain and inventory management (introduction, need, attributes and function).

UNIT-IV

World trade agreements related with food business, export and prospects of food products in India. Consumer behaviour towards food consumption, consumer surveys by various institutes and agencies.

Recommended readings:

1. Kottler (1994). *Marketing Management:* Prentice Hall of India, New Delhi.
2. Baker, G. A., Grunewald, O. & Gorman, W. D. (2002). *Introduction to food and agribusiness management:* Prentice Hall of India, New Delhi.
3. Khanks, S. S. (1999). *Entrepreneurial Development:* Chand and company, New Delhi.
4. Jakobsen, G. & Torp, J. E. (2001). *Understanding business systems in developing countries.*
5. Ahmad, S. M. (2000). *Management Info Guide*.

Course Outcomes:

1. Ability to understand the basic concepts of marketing of food items.
2. Ability to understand market types, the procurement, marketing and management of raw and processed agricultural produce meant for human consumption.
3. Acquire knowledge of the legal and ethical environment impacting agriculture organizations and effectively evaluate the impact of trade policy.
4. Understand the need for careful management of a business human resources.
5. Understand the impact of planning, decision making and risk taking on an agri-business.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	1	1
PO3	2	2	2	2	2
PO4	3	3	3	3	3
PO5	1	1	1	1	1
PO6	1	1	1	1	1
PO7	2	2	2	2	2
PO8	1	1	1	1	1
PO9	1	1	1	1	1

UC-MSFT-614- 19: LAB – VIII (TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS)

Total Marks: 50

L	T	P
0	0	4

Objective:

To familiarize the students with quality tests of wheat flour and yeast with reference to bread processing and to equip them with the necessary skills for bread, biscuits and cookies processing.

List of experiments:

1. Estimation of different physicochemical characteristics of cereals grains.
2. Milling quality evaluation of wheat grains.
3. Functional quality test of wheat flour-
    a. Wet & dry gluten content
    b. SDS sedimentation maltose value
    c. Falling number values of wheat flour
    d. Dough raising capacity of yeast.
4. Rheological tests of wheat flour-
    a. Viscoamylographic characteristics
    b. Farinographic characteristics
    c. Extensographic characteristics
    d. Effect of different oxidizing & reducing agents on the farinographic & extensographic characteristics.
5. Test baking of bread, biscuits and cake.
6. Milling of rice.
7. Effect of parboiling treatment on the milling quality of rice.
8. Effect of degree of polishing on the milling quality of rice.

Course Outcomes:

1. Student shall be well versed with Processing Techniques of Cereals.
2. Student shall be well versed with quality parameters of cereals.
3. Student will be able to understand practical implication of Milling of Wheat & Rice.
4. Student will be able to get acquaintance with machinery being utilized in Milling of Wheat & Rice.
5. Student will be able to understand Lab SOPs for above.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	2	2	1
PO2	2	2	2	2	1
PO3	3	3	3	3	2
PO4	3	3	3	3	3
PO5	3	2	3	3	3
PO6	2	2	2	2	1
PO7	3	3	3	3	2
PO8	3	2	3	3	3
PO9	3	3	3	3	3

ELECTIVE-II

UC-MSFT-615- 19: FOOD ADDITIVES

Total Marks: 100	L	T	P
	4	0	0

Objective:

To impart knowledge about additives in food processing, types of food additives, chemical nature, their analysis and risk and benefits.

UNIT-I

General classification, types, uses, functions, legal aspects, risks and benefits. Preservatives-antimicrobial agents (types, mode of action and their application). Antioxidants (types and mechanism of oxidation inhibition). Anti-browning agents (types, functions and mode of action).

UNIT-II

Coloring Agents: synthetic food colorants, color chemistry, application and levels of use, natural colorants, sources of natural color (plant, microbial, animal and insects), misbranded colors, color extraction techniques.
Flavoring agents: sweeteners (nutritive and non-nutritive), flavors (natural and synthetic flavors), off-flavor in foods, flavor enhancers, flavor stabilization. flavor encapsulation.

UNIT-III

Emulsifiers: types, selection of emulsifiers, emulsion stability, functions and mechanism of emulsifiers. Stabilizers: types, uses and functions.
Chelating agents and sequestrants: types, uses and mechanism.
Acidulents and pH control agents: types, uses and mode of action.

UNIT-IV

Nutritional additives: types and uses, Spices and condiments- chemical composition, uses and special attributes of important Indian spices, seasoning blends, extraction of spices, general processing of spices.

Recommended readings:

1. Emerton, V. & Choi, E. (2008). *Essential Guide to Food Additives* (3rd ed.): *RSCP, UK.*
2. *Ashurst, P. R. (1995). Food Flavorings* (2nd ed.): Chapman and Hall, Glasgow.
3. Crompton, T. R. (2007). *Additive Migration from Plastics into Foods: A Guide for Analytical Chemistry:* Smithers Rapra, Shawbury.
4. Brannel, A. L., Davidson, P. M. & Salminen, S. (1990). *Food Additives:* Marcel Dekker, New York.
5. Hirasa, K. & Takemasa, M. (1998). *Spice Science and Technology:* Marcel Dekker, New York.

Course Outcomes:

1. Student shall gain a thorough knowledge of Chemical Nature, Analysis, Risk & Benefits of Food Additives.
2. Student shall gain a thorough knowledge of Antimicrobial Agents, Antioxidants & Anti Browing Agents.
3. Student shall gain a thorough knowledge of Synthetic Food Additives (Coloring Agents, Flavoring Agents).

4. Student shall gain a thorough knowledge of Emulsifier, Stabilizer Chelating Agents, Acidulents & pH control agents.
5. Student shall gain a thorough knowledge of Nutritional Additives along with their properties.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	3	2	3	3
PO2	3	2	3	3	2
PO3	1	2	1	1	2
PO4	2	1	2	2	1
PO5	1	1	2	1	1
PO6	3	3	2	3	3
PO7	2	3	3	2	3
PO8	2	3	2	2	3
PO9	2	2	3	2	3

UC-MSFT-616- 19: NUTRITION AND HEALTH

Total Marks: 100	L	T	P
	4	0	0

Objective:

To understand the importance of various nutrients and effects of imbalance in human health.

UNIT-I

Foods and nutrients-basic definitions, functions of food and nutrients, levels of nutritional status, changing concepts of nutrition. Major world health problems- food supply and security, malnutrition, heart diseases, cancer, diabetes etc. Recommended dietary allowances (R.D.A.), ICMR standards, food guide, exchange lists, health promotion guidelines.

UNIT-II

Carbohydrates: classification, dietary importance, special functions of carbohydrates in body tissues, relationship between dietary fiber and various health problems. Fats- health needs of fat, health problems with fat, essential fatty acids, visible and hidden food fat, cholesterol, lipoproteins. Energy balance-food energy measure, energy control in human metabolism, basal metabolic rate (B.M.R.), factors affecting B.M.R., measuring B.M.R., energy requirements and its estimation.

UNIT-III

Proteins: nature and essentiality of amino-acids and proteins, functions of protein, concept of protein balance, factors influencing protein requirements, comparative quality of food proteins, biological value, net protein utilization, protein efficiency ratio, other methods of evaluation of protein quality. Vitamins-definition, general nature and classification, clinical applications, sources, requirements and functions of Vitamin A, D, E, K, C and B complex vitamins. Vitamin toxicity.
Minerals: minerals in human health, functions, clinical applications, food sources and requirements, trace elements and their importance in diet.

UNIT-IV

Psychologic influences on food habits-motivation, perception, food misinformation, food faddist claims, vulnerable groups. Drug food interactions-drug effects on food intake, drug effects on nutrient absorption, vitamin antagonists. Nutrition and weight management- obesity and its causes, body composition, B.M.I., weight for height measures, health implications of obesity, and problems of weight management.

Recommended readings:

1. ICMR. (2011). *Nutrient Requirement & RDA:* ICMR, New Delhi.
2. Elia, M., Ljungqvist, O. & Stratton, R., J. (2013). *Clinical Nutrition.*
3. Hegarty, V. (1992). *Nutrition Food and the Environment:* Eagen Press.
4. Brian, A. F. & Allen, G. (1995). *Food Science, Nutrition & Health:* Edward Arnold, member of Hodder Headline Group London, Sydney, Auckland.
5. Macrae, R., Robinson, R. K. & Sadler, M.J. (1993). Encyclopedia of Food science, Food technology and Nutrition.
6. Williams, S. R. (1990). *Essentials of Nutrition and Diet Therapy:* Times Mirror / Mosby College Publishing.

Course Outcomes:

After completing this course, you should be able to

1. Utilize knowledge from the physical and biological sciences as a basis for understanding the role of food and nutrients in health and disease processes.
2. Describe the digestion and metabolism of the energy nutrients (carbohydrates, lipids, protein) and non-energy nutrients (vitamins/minerals).
3. Distinguish sound nutritional information from unreliable nutritional information.
4. Describe a healthy diet and food choices, and explain why such choices will help prevent health problems.
5. Review Biochemistry of Energy Transfer particularly the lactic acid system and the aerobic systems.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	2	1	1	3
PO2	2	1	1	1	2
PO3	1	1	1	2	2
PO4	2	1	1	1	1
PO5	1	1	1	3	1
PO6	2	1	2	1	1
PO7	1	2	2	2	1
PO8	1	1	3	1	2
PO9	2	2	1	2	1

UC-MSFT-617- 19: LAB - IX (Food Additives)

Total Marks: 50

L	T	P
0	0	4

Objectives:

To acquaint students to the methods of determination of additives in food system.

List of experiments:

1. Determination of benzoic acid in the presence of saccharin in the Ready-to Serve beverages.
2. Estimation of nitrate and nitrite, aspartame, saccharine and caffeine.
3. Identification of natural colours.
4. Estimation of synthetic food colours, oil soluble colours, antioxidants.
5. Detection of brominated vegetable oils in soft drinks, magnesium carbonate in pan masala / gutka.
6. Food applications of emulsifiers, stabilizers, thickeners, favours and flavour enhancers.

Course Outcomes:

1. Ability to do Chemical Analysis of Additives in food items.
2. Ability to estimate Food Additives for extension of shelf life & safety.
3. Ability to hire good perception of quality of food by addition of additives.
4. Ability to identify suitable additives for various food items.
5. Ability to acquire commercial aspects of food additives related to food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	3	2	3	3	1
PO2	3	3	2	3	1
PO3	2	3	3	2	2
PO4	1	2	1	3	3
PO5	2	1	2	1	1
PO6	3	3	1	3	3
PO7	3	3	1	2	2
PO8	2	2	2	1	2
PO9	2	1	2	2	3

UC-MSFT-618- 19: LAB - X (NUTRITION AND HEALTH)

Total Marks: 50

L	T	P
0	0	4

Objectives:

To train students in nutrient analysis and basics of meal planning.

List of experiments:

1. Proximate analysis of foods– Moisture, protein, ether extract, fiber, starch, soluble sugars, ash content.
2. Calorific value of foods using Bomb Calorimeter.
3. Protein analysis by Spectrophotometeric method.
4. Protein quality evaluation (Protein digestibility *in vitro*).
5. Starch digestibility (*in vitro*).
6. Amylase inhibitor activity.
7. Trypsin inhibitor activity.
8. Estimation of polyphenols/tannins, phytic acid, calcium, phosphorus, iron content.
9. Phytase activity determination in pulses.
10. Mineral analysis using Atomic Absorption Spectrophotometer.
11. Assessment of effect of processing method (e g. Frying / Microwave cooking / Germination on nutritive value of foods.
12. Nutritional assessment and dietary adequacy in terms of various nutrients.
13. Planning a diet using “Food Composition Tables” (ICMR).
14. Diet planning using “Food Exchange” method.
15. Standardization of nutritious snacks (Protein rich / Energy rich / Low calorie / Calcium rich / Iron rich / Vitamin rich), nutritious snacks for specific physiological needs (Infant weaning / Pre-schooler / School children/ Old people).

Course Outcomes:

At the completion of the program the student will:

1. Describe methods used to assess nutrition status.
2. Describe the methods used to carry out nutrition research.
3. Understand how nutrition science studies are designed, analyzed and interpreted.
4. Experience in functioning within a team.
5. Students will be able to demonstrate critical thinking skills to analyze data and interpret results in the nutritional sciences.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	2	1	1	1
PO3	1	3	2	2	1
PO4	1	1	1	3	1
PO5	2	2	3	1	3
PO6	1	1	2	1	2
PO7	2	2	2	1	1
PO8	2	3	1	1	3
PO9	3	1	1	3	1

SEMESTER

FOURTH

UC-MSFT-621- 19: SNACK FOOD TECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

To impart knowledge related to various snack foods and their manufacturing techniques.

UNIT-I

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 de-volatilization. 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: 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: 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- chips, wafers; Technology for coated nuts- salted, spiced and sweetened chikkies. Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping.

Recommended Readings:

1. Booth, R. G. (1997). *Snack Food:* CBS, New Delhi.
2. Raymond, W. L. & Rooney, L. W. (2001). *Snack Foods Processing:* CRC. London.
3. Lusas, E. W. & Rooney, L. W. (2015). *Snack Foods Processing:* CRC. London.
4. Guy, R. (2001). *Extrusion Cooking: Technologies and Applications:* Woodhead, USA.
5. Riaz, M. N. (2000). *Extruders in Food Applications:* Technomic, Lanchester.

Course Outcomes:

1. Students shall be able to understand Basics of Preparing Extruded Snack Foods Items along with working of equipments related to extrusion of Food Products.
2. Students shall be able to understand preparation of Breakfast Snacks in particular cereal based Snacks Food Items.
3. Students shall be able to understand preparation of Grain based Snacks Food Item.
4. Students shall be able to understand preparation of Fruits & Vegetables based Snack Item along with introduction of related equipments.

5. Students shall be able to understand Basics Kitchen Recipe with scaling up to Commercial Level of all above.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	2	1
PO2	1	1	1	1	1
PO3	3	3	3	3	2
PO4	1	1	1	1	1
PO5	1	1	1	1	1
PO6	1	1	1	1	1
PO7	2	2	2	2	1
PO8	1	1	1	1	1
PO9	3	2	2	2	2

UC-MSFT-624-19: Dissertation

L	T	P
0	0	24

A student is required to undertake a Dissertation of 12 credits. The dissertation shall be evaluated at the end of the Semester IV as per notification no. IKGPTU/Reg/NF/157 dated 04/04/2019.

ELECTIVE-III

UC-MSFT-622- 19: FOOD BIOTECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

Imparting knowledge about principles of genetic engineering, use of biotechnology in the production of modified foods, enzymes, vitamins and proteins.

UNIT-I

Introduction to food biotechnology, basic principles of gene cloning, food safety and biotechnology. Impact of Biotechnology on microbial testing of foods. Immunological methods, DNA based methods in food authentication, real time PCR (polymeric chain reaction) based methods.

UNIT-II

Transgenic plants- current status, methods, prospects, risks and regulation. Transgenic Animals- methods and applications, ethical issues.

UNIT-III

Natural control of micro-organisms– bacteriocins of lactic acid bacteria, applications of bacteriocins in food systems. Aflatoxins– production, control and reduction using molecular strategies. Protein engineering in food technology– methods, objectives, limitations and applications of protein engineering (glucoseisomerase, lactobacillus β-galactosidase and peptide antibiotic nisin).

UNIT-IV

Biotechnology and food ingredients – biogums, fats, oils, fatty acids and oilseed crops, fat substitutes, citric, fumaric and malic acids, bioflavours and biocolors. Biosensors- principle, types and applications in food processing.

Recommended readings:

1. Joshi, V. K. & Pandey, A. (1999). *Biotechnology- Food Fermentation Microbiology, Biochemistry and Technology:* EPD, New Delhi.
2. Gutierrez, G. F. & Barbosa-Canovas, G. V. (2003). *Food Science and Food Biotechnology:* CRC Press, Boca raton.
3. Chawla, H. S. (2000). *Introduction to Plant Biotechnology:* Oxford & IBH, New Delhi.
4. Chawla, H. S. (1998). *Biotechnology in Crop Improvement:* International, Lucknow.
5. Saha, B. C. (2003). *Fermentation Biotechnology:* ACS, Washington.

Course Outcomes:

At the completion of the program the student will:

1. Knowledge and understanding of definition and the different uses of food biotechnology. These include the tools used, production of recombinant proteins and additives to use in food technology, transgenic foods, diagnostic system used in food industry, and ethics and safety of food biotechnology.
2. After the course the students are expected to understand new development in the field with analytical thinking of the various aspects of the new technology.
3. Students are expected to ask questions and participate in discussions.
4. Appraise the applications and implications of genomics and genetic modification on foods.

5. Describe the beneficial effects of microorganisms on foods with regards to nutritional and functional properties.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	3
PO2	1	1	1	1	2
PO3	3	1	1	3	1
PO4	2	1	1	1	1
PO5	1	2	1	2	1
PO6	1	1	2	3	1
PO7	3	1	1	1	2
PO8	1	3	2	1	1
PO9	1	1	3	1	1

UC-MSFT–623- 19: TECHNOLOGY OF MEAT, FISH AND POULTRY

Total Marks: 100	L	T	P
	4	0	0

Objective:

This course shall educate students about the significance and necessity of organized animal products sector, humane slaughtering of animals and poultry and value addition of meat, poultry, egg and fish.

UNIT-I

Status and scope of meat industry. Traditional and scientific methods of slaughter of meat animals and birds, humane methods of slaughter. Structure, composition and nutritive value of meat. Conversion of muscle into meat. Factors affecting meat quality. Post-mortem changes in meat, thaw rigor, cold shortening, pre-rigor processing.

UNIT-II

Storage and preservation of meat, fish and poultry: chilling, freezing, curing, smoking, dehydration, freeze drying, irradiation, canning and glazing of fish. Eating quality of meat- color, flavor, tenderness, juiciness, water holding capacity, warmed over flavour in meats. Restructured meat products- sausages and comminuted meat products, ingredients used and their significance. Meat tenderization techniques. Ageing of meat.

UNIT-III

Quality of fresh fish. Processing of fish. Manufacturing of fish paste, fish sauces, fish oil, fish protein concentrate.
Structure, composition and nutritive value of eggs. Storage and preservation of shell eggs. Functional properties of eggs, factors affecting functional properties, mechanism and measurement.

UNIT-IV

Quality of eggs- internal and external quality evaluation, candling, albumen index, haugh unit, shape index, yolk index etc. Grading of eggs. Pasteurization, dehydration, freezing and desugerization of egg. Liquid egg products, egg powder, value added egg products (e.g., meringues, poached etc.). Packaging of egg and egg products.
Utilization of meat, fish and egg industry by-products: importance, food and non-food applications.

Recommended Readings:

1. Varnam, A. H. & Sutherland, J. P. (1995). *Meat and Meat Products: Technology, Chemistry and Microbiology:* Champan & Hill, London.

2. Lawrie, R. A. (1998). *Lawrie's Meat Science* (6th ed.): Woodhead, Cambridge.
3. Kerry, J., Kerry, J. & Ledward, D. (2002). *Meat Processing Improving Quality:* CRC Press, USA.
4. Hui, Y. H. (2010). *Handbook of Poultry Science and Technology*.
5. Fernandes, R. (2009). *Fish and Seafood*.

Course Outcomes:

1. Student shall know about the significance & necessity of organized animal product sector.
2. Students shall acquire the ability of value- addition to Meat, Poultry, Egg & Fish.

3. Student shall be well versed with processing, preservation & quality control of Meat, Egg & Fish in Food Industry.
4. Student shall be well versed with manufacturing practices of egg based, fish based and meat based by products & their processing techniques.
5. Student will be having broad knowledge of status & scope of Meat, Egg, & Poultry industry world wide.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	3	3	1	1
PO2	1	1	3	1	1
PO3	3	3	2	2	2
PO4	3	3	1	3	3
PO5	1	1	1	3	1
PO6	1	1	3	2	1
PO7	2	2	1	1	2
PO8	1	1	1	1	1
PO9	2	2	2	3	3

Study Scheme & Syllabus of

Master of Science in Clinical Research

(M.Sc. Clinical Research)

Batch 2020 Onward

By

Board of Study Clinical Research

Main Campus

IK Gujral Punjab Technical University

IK Gujral Punjab Technical University

Vision

To be an institution of excellence in the domain of higher technical education that serves as the fountainhead for nurturing the future leaders of technology and techno-innovation responsible for the techno-economics, social, cultural and environmental prosperity of the people of the State of Punjab, the Nation and the World

Mission

To provide seamless education through the pioneering use of technology, in partnership with industry and society with a view to promote research, discovery and entrepreneurship and to prepare its students to be responsible citizens of the world and the leaders of technology and techno-innovation of the 21st Century by developing in them the desirable knowledge, skill and attitudes base for the world of work and by instilling in them a culture for seamlessness in all facets of life.

Department of Food Science and Technology

Vision

To create competent professionals those contribute towards the economic development of the nation by going in line with the policy of Government of India in the field of food processing, food safety, health and nutrition.

Mission

- Development of human resource in the field of food science and technology to serve the cause of nation
- Development of human resource in the area of clinical nutrition and research to contribute effectively in making India healthy
- Providing a strong theoretical and practical background across the food science discipline with an emphasis on developing sustainable resources to cater food and nutrition related challenges
- Create favourable environment for innovation to translate theoretical knowledge into practical applications
- Inculcating professional ethical values, innovative research capabilities and leadership abilities
- Holistic development of the youth through the process of self evaluation and continuous improvement

MSc. Clinical Research

Programme Educational Objectives

PEO1	To accomplish the demand for well qualified clinical researchers in academia and industry
PEO2	To pursue successful industrial, academic and research careers in specialized fields of clinical research and drug safety
PEO3	Solve problems through application of critical thinking and evidence-based processes
PEO4	To sensitize students about the importance of ethical practices in clinical research and practice
PEO5	Pursue self-learning to remain abreast with latest developments for continuous professional growth

Programme Outcomes

PO1	Ability to participate and contribute effectively as clinical research team member
PO2	Understand the roles and responsibilities of the different stakeholders in clinical research
PO3	Compare and summarize international regulations, clinical requirements and best practices for the clinical research process
PO4	Integrate knowledge from foundational sciences and pharmaceutical sciences for effective planning and implementation of study protocols
PO5	Apply knowledge of disease pathophysiology and current therapy in designing clinical trial protocols and analyzing data
PO6	Evaluate the suitability, accuracy, and reliability of clinical study data by analyzing experimental design, statistical tests, interpreting results, and formulating conclusions
PO7	Ability to review existing evidence in literature
PO8	Describe Good Clinical Practices in different aspects of the clinical studies
PO9	Communicate professionally both orally and in writing within the clinical research environment

Mapping of Program Outcomes with Program Educational Objectives

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	1	1	1	1
PO2	3	2	1	1	1
PO3	1	3	2	3	2
PO4	3	2	3	2	3
PO5	2	3	3	2	3
PO6	3	3	3	1	3
PO7	3	3	3	2	3
PO8	2	2	2	3	2
PO9	2	3	1	1	3

1: Slightly 2: Moderately 3: Substantially

Duration of course	Two Academic Years
Maximum duration for course completion & award of degree	4 Years
Eligibility	Graduation with minimum 50% marks in Life Sciences/Sciences/Medical Sciences/Pharmacy
Attendance Requirement	75%
Examination System	Semester
Marks Allocation	• Theory courses of 04 credits = 100 marks • Theory courses of 02 credits = 50marks • Practical courses of 02 credits = 50 marks
Minimum Credits for Award of Degree	• 90
Programme Structure	1. Compulsory Foundation Course 2. Core Courses 3. Elective Courses 3.1. Discipline Specific Elective Courses 3.2. Generic Elective Courses 4. Ability Enhancement Courses 5. Skill Enhancement Courses

Programme Structure

1. **Compulsory Foundation Course:** This course is a foundation course designed with the object to enhance the knowledge base of students.

2. **Core Courses:** These courses are compulsory courses studied by students as core requirement of the programme. These courses aim to impart students the basics of the MSc. Clinical Research programme.

3. **Discipline Specific Elective (DSE) Courses:** Discipline specific elective courses comprise a pool of courses offered under the main discipline/subject of study. Students will choose DSE courses from a pool of courses provided to them.

4. **Generic Elective (GE) Courses:** Generic elective comprise a pool of courses designed with a purpose to offer the students the opportunity to explore disciplines of interest beyond the choices they make in core and discipline specific elective courses. Students will choose GE courses from a pool of courses provided to them.

5. **Ability Enhancement Courses:** These courses are designed with the aim to improve the knowledge base and skills of the students to facilitate employability.

6. **Skill Enhancement Courses:** These courses are designed with the aim to improve the knowledge base and skills of the students to facilitate employability.

Internal Assessment

- The internal assessment will have two components i.e. **Continuous Mode** and **Sessional Exams**

1. For Theory Courses having Internal of 30 Marks the scheme of internal award is:
    - Sessional Exams: 20 Marks
    - Continuous Mode: 10 Marks

Sessional Exams

- The number of sessional exams and criteria for computation i.e. average marks or best of sessional exams conducted shall be according to guidelines provided by Academic Council IKG-PTU from time to time.
- Sessional exam shall be **conducted for 30 marks** for theory and shall be **computed for 20marks**.

Continuous Mode Scheme

Criteria	Maximum Marks
*Attendance (as per table given below)	4
Academic activities (Average of any 3 activities e.g. quiz, assignment, open book test, field work, group discussion and seminar)	6
Total	**10**

2. For Theory Courses having Internal of 15 Marks the scheme of internal award is:
    - Sessional Exams: 10 Marks
    - Continuous Mode: 05 Marks

Sessional Exams

- The number of sessional exams and criteria for computation i.e. average marks or best of sessional exams conducted shall be according to guidelines provided by Academic Council IKG-PTU from time to time.
- Sessional exam shall be **conducted for 20 marks** for theory and shall be **computed for 10marks**.

Continuous Mode Scheme

Criteria	Maximum Marks
*Attendance (as per table given below)	2
Academic activities (Average of any 3 activities e.g. quiz, assignment, open book test, field work, group discussion and seminar)	3
Total	**5**

Evaluation Scheme of Laboratory Courses

Internal (30 Marks)	Continuous and Comprehensive Evaluation (class performance/practical record/viva etc.) = 26
	*Attendance (as per table given below) = 04
External (20 Marks)	Synopsis = 05
	Performance = 10
	Viva = 05
Total	**50 Marks**

*Guidelines for the Allotment of Marks for Attendance

Percentage of Attendance	Theory (Attendance Maximum Marks 04)	Theory (Attendance Maximum Marks 02)	Practical (Attendance Maximum Marks 04)
More Than 93	4	2	4
87 – 92	3	1.5	3
81– 86	2	1	2
75 – 80	1	0.5	1
Less than 75	0	0	0

Evaluation Scheme Journal Club

Paper Selection and Content Delivery	10
Power Point Presentation	05
Post Presentation Discussion	10
Total	25

Note: Student will present minimum two papers in each semester

Question Paper Pattern for Theory Sessional Examinations of 30 Marks

Objective Type Questions (5x2) (Answer all the questions)	5x2=10
Short Answers (Answer 2out of 3)	2x5 =10
Long Answers (Answer 1 out of 2)	1x10=10
Total	**30 Marks**

Question Paper Pattern for Theory Sessional Examinations of 20 Marks

Objective Type Questions(5x1) (Answer all the questions)	5x1= 05
Short Answers(Answer 1out of 2)	1x5 = 05
Long Answers(Answer1out of 2)	1x10=10
Total	**20 Marks**

Question Paper Pattern for Theory External Exam of 70 Marks

Objective Type Question (10 x 2) (Answer all the questions)	10 x 2 = 20
Short Answer (Answer 4 out of 5)	4 x 5 = 20
Long Answer (Answer 3 out of 4)	3 x 10 = 30
Total	**70 Marks**

Question Paper Pattern for Theory External Exam of 35 Marks

Objective Type Question (5 x 1) (Answer all the questions)	5 x 1 = 05
Short Answer (Answer 2 out of 3)	2 x 5 = 10
Long Answer (Answer 2 out of 3)	2 x 10 = 20
Total	**35 Marks**

First Semester

Course Code	Course Type	Course Name	Load			Marks			Credits
			L	T	P	Internal	External	Total	
UC-MSCR101-19	Foundation Course	Foundation Course	3	1	-	30	70	100	4
UC-MSCR102-19	Core Theory	Fundamentals of Clinical Research	3	1	-	30	70	100	4
UC-MSCR103-19	Core Theory	General Pharmacology	3	1	-	30	70	100	4
UC-MSCR 104-19	Core Practical	Clinical Research Lab I	-	-	4	30	20	50	2
UC-MSCR 105-19	Ability Enhancement	Professional Communication	2	-	-	15	35	50	2
UC-MSCR 106-19	Skill Enhancement	Journal Club	-	-	4	50	-	50	2
UC-MSCR XXX	Discipline Specific Elective Theory	Elective –I	2	-	-	15	35	50	2
UC-MSCRYYY	Generic Elective Theory	Elective –II	2	-	-	15	35	50	2
		Total	**15**	**3**	**8**	**215**	**335**	**550**	**22**

Discipline Specific Elective Theory (Elective-I)

Subject Code	Subject Name
UC-MSCR 111-19	Intellectual Property Rights
UC-MSCR 112-19	Different Systems of Medicine

Generic Elective Theory (Elective-II)

Subject Code	Subject Name
UC-MSCR 113-19	Clinical Pharmacokinetics
UC-MSCR 114-19	Alternatives in Toxicity Testing
UC-MSCR 115-19	Fundamentals of Physiology

Second Semester

Course Code	Course Type	Course Name	Load			Marks			Credits
			L	T	P	Internal	External	Total	
UC-MSCR201-19	Core Theory	Pharmacotherapeutics - I	3	1	-	30	70	100	4
UC-MSCR202-20	Core Theory	Clinical Research Regulations & Ethics	3	1	-	30	70	100	4
UC-MSCR203-19	Core Practical	Clinical Research Lab II	-	-	4	30	20	50	2
UC-MSCR 204-19	Ability Enhancement	Professional Communication Lab	-	-	4	30	20	50	2
UC-MSCR 205-20	Skill Enhancement	Medical Writing	2	-	-	15	35	50	2
UC-MSCR 206-19	Skill Enhancement	Journal Club	-	-	4	50	-	50	2
UC-MSCR XXX	Discipline Specific Elective Theory	Elective –III	2	-	-	15	35	50	2
UC-MSCRYYY	Generic Elective Theory	Elective –IV	2	-	-	15	35	50	2
		Total	**12**	**2**	**12**	**215**	**285**	**500**	**20**

Discipline Specific Elective Theory (Elective-III)

Subject Code	Subject Name
UC-MSCR 211-19	Fundamentals of Epidemiology
UC-MSCR 212-19	International Regulatory Affairs

Generic Elective Theory (Elective-IV)

Subject Code	Subject Name
UC-MSCR 213-19	Biostatistics in Clinical Research
UC-MSCR 214-19	Poisoning and Management

Third Semester

Course Code	Course Type	Course Name	Load			Marks			Credits
			L	T	P	Internal	External	Total	
UC-MSCR301-19	Core Theory	Pharmacotherapeutics -II	3	1	-	30	70	100	4
UC-MSCR302-20	Core Theory	Clinical Study Design	3	1	-	30	70	100	4
UC-MSCR303-19	Core Theory	Research Methodology	2	-	-	15	35	50	2
UC-MSCR304-19	Core Theory	Pharmacovigilance	2	-	-	15	35	50	2
UC-MSCR 305-19	Core Practical	Clinical Research Lab III	-	-	4	30	20	50	2
UC-MSCR 306-19	Skill Enhancement	ICT Skills Lab	-	-	4	30	20	50	2
UC-MSCR 307-19	Skill Enhancement	Journal Club	-	-	4	50	-	50	2
UC-MSCR 308-19	Research Work	Synopsis	-	-	4	50	-	50	2
UC-MSCR XXX	Discipline Specific Elective Theory	Elective –V	2	-	-	15	35	50	2
UC-MSCRYYY	Generic Elective Theory	Elective –VI	2	-	-	15	35	50	2
		Total	**14**	**2**	**16**	**280**	**320**	**600**	**24**

Discipline Specific Elective Theory (Elective-V)

Subject Code	Subject Name
UC-MSCR 311-20	Clinical Trial Operations
UC-MSCR 312-19	Medical Coding

Generic Elective Theory (Elective-VI)

Subject Code	Subject Name
UC-MSCR 313-19	Pharmacoeconomics & Health Technology Assessment
UC-MSCR 314-20	Quality Management in Clinical Trials

Fourth Semester

Course Code	Course Type	Course Name	Load			Marks			Credits
			L	T	P	Internal	External	Total	
UC-MSCR401-19	Seminar	Seminar	-	-	4	50	-	50	2
UC-MSCR402-19	Research Work	Dissertation	-	-	36	200	100	300	18
--	Co-curricular Activities	--	--	--	--	*Satisfactory/Unsatisfactory			--
		Total	**-**	**-**	**40**	**250**	**100**	**350**	**20**

Semester Wise Credits Distribution

Semester	Credits
I	22
II	20
III	24
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Activities)	04
Total Credit Points	**86 + 4* = 90**

- *Credits for Co-curricular Activities
- *Credits not included towards calculation of CGPA
- The award of credits for co-curricular activities will have only internal component
- The student will earn the credits for co-curricular activities anytime during the duration of MSc.
- Head of Department will award the credits based upon the submission of relevant documents pertaining to criteria as below by student.

Guidelines for Awarding Credits for Co-curricular Activities

Name of the Activity	Credit Points
Successful completion of MOOCs Courses (4 weeks)	04
Successful completion of MOOCs Courses (2 weeks)	02
Hospital Training (minimum 4weeks)	02
Participation in Seminar/ Conference/ Symposium (related to the specialization of the student)	01
Participation in Workshop/ Training Programs of duration one week (05 days) or more (related to the specialization of the student)	02
Presentation in Seminar/ Conference/ Symposium / (related to the specialization of the student)	02
Presentation in Seminar/ Conference/ Symposium / (related to the specialization of the student) and with award	03
Research / Review Publication in indexed in Scopus / Web of Science*	03
Research / Review Publication in peer reviewed journals*	02
Minimum ten days residential camp organized by NSS/ Youth Affairs	02
Inter University participation in cultural or sports activity	02
Inter University award in cultural or sports activity	03
Inter College participation in cultural or sports activity	01
Inter College award in cultural or sports activity	02

**Only those research / review publications will be considered which have been published during the tenure of M. SC. Course.*

FIRST SEMESTER

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 101-19	Foundation Course	3	1	-	30	70	1.5	3	4

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is based upon the content that leads to knowledge enhancement. This course is mandatory for bringing the student of different background on a common platform.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basics of chemistry and analytical techniques
CO2	Develop an understanding in the basics of biochemistry and cell biology of the human body
CO3	Understand the significance of the environment related issues in the new drug discovery and development
CO4	Develop an understanding of contribution of genetic factors involved in the holistic treatment of the diseases
CO5	Apply the knowledge of biotechnology in the field of drug discovery and clinical trials

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	3	1	2	1	2	1
CO2	2	1	2	3	3	1	2	1	1
CO3	1	2	3	2	1	1	1	3	1
CO4	3	1	2	3	3	2	2	1	1
CO5	2	1	1	3	2	2	1	1	1

Module-I **08 Hrs**

Chemistry

Solution — Methods of expressing the concentration (molality, molarty, normality, formality etc)

Laws of mass action, reaction quotient, chemical equilibrium constant, relation of Kp & Kc, pH, buffer, buffer index, buffer capacity, arrhenius equation

Principles, classification and applications of chromatographic techniques

Basics of Spectroscopy and applications

Module-II **15 Hrs**

Biochemistry and Cell Biology

Biomolecules - carbohydrates, amino acids/proteins, lipids and nucleotides; enzymes: characteristics and nomenclature

Introductory cell biology & microbiology: prokaryotes & eukaryotes; the cell and its composition; cell organelles and subcellular fractionation; viruses, viroid's, virusoids and prions: bacterial culture and growth curve

Immunology – natural and acquired immunity; humoral and cellular immunity; vaccines and immunization; Clonal selection theory; Cells of immune system; immunoglobulins, haptens, antigens and immunogens; monoclonal & polyclonal antibodies

Clinical biochemistry: common biochemical tests; acid base disorders; liver function tests; kidney function tests

Module-III **08 Hrs**

Environmental Sciences

Biodiversity — concept, levels and conservation of biodiversity

Climate change and its consequences

Ecosystem - producers, consumers and decomposers of food chain

Environmental pollution, bioremediation

Module-IV **14 Hrs**

Genetics and Biotechnology

Genetics of inheritance - laws of inheritance, recombination and segregation of traits, segregation ratio, interaction between traits and quantitative inheritance

Molecular Biology - the genetic material, RNA as genetic material, fidelity of DNA replication, transcription, translation and transduction, mutation and mutagenesis, ames test

Genetic Engineering - essentials of gene manipulation, vectors & enzymes used in recombinant technology

Biotechnology: stem cell, its application and ethical aspects

Suggested Readings/Recommended Books (Latest Editions)

1. AI Vogel, Text Book of Quantitative Inorganic analysis, Pearson.
2. Wilson and Walker, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University.
3. Bentley and Driver's Textbook of Pharmaceutical Chemistry, Oxford University Press.
4. Anand and Chatwal, Inorganic Pharmaceutical Chemistry, Himalaya.
5. DRFerrier, Lippincott's Illustrated Reviews: Biochemistry, Wolters Kluwer India Pvt. Ltd.
6. Principles of Biochemistry by Lehninger, W H Freeman & Co.
7. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell, Lange.
8. Biochemistry by Stryer, WH Freeman.
9. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India.
10. Agarwal, K.C. Environmental Biology, Nidhi Publ. Ltd. Bikaner.

11. Cunningham, W.P. Cooper, T.H. Gorhani, E and Hepworth, M.T., Environmental Encyclopedia, Jaico Publishing House, Mumbai.
12. Instrumental Methods of Chemical Analysis by B.K. Sharma, Krishna Prakashan Media (P) Ltd.
13. Quantitative Analysis of Drugs by D.C. Garrett, Springer.
14. Lodish, Molecular Cell Biology. New York :WH Freeman.
15. TA Brown, Gene Cloning and DNA Analysis: An Introduction, Wiley Blackwell.
16. GM Cooper, The Cell: A Molecular Approach, ASM Press.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 102-19	Fundamentals of Clinical Research	3	1	-	30	70	1.5	3	4

Pre-requisite: None

Co- requisite: General Pharmacology (UC-MSCR103-19)

Course Objectives: The objective of the course is to create understanding of basic concepts of clinical research, clinical terminology and clinical trial definition. Further to give overview of the documentations in clinical research.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the strategies and techniques involved in drug discovery process
CO2	Appreciate the impact of pharmaceutics science in new drug development and clinical use of drugs
CO3	Understand the preclinical phase of drug development
CO4	Understand different phases of clinical trials
CO5	Understand the importance of use of placebo controls and placebo response in clinical trials

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	2	2	3	2	1	1
CO2	1	2	1	3	1	2	3	1	1
CO3	1	1	1	3	2	2	3	1	1
CO4	2	3	3	3	3	2	1	3	1
CO5	2	3	3	2	3	2	2	2	1

Module-I **14 Hrs**

Drug Discovery Process

Approaches to drug development
Combinatorial chemistry
Lead optimization, target-centred drug design
The drug development process high throughput screening (HTS)

Module-II **09 Hrs**

Formulation Development

Introduction to different formulations, advantages and disadvantages of common formulations
Introduction to manufacturing of drugs and Good Manufacturing Practices (GMP)
Quality assurance and quality control during manufacturing a drug
Biopharmaceutical classification on drugs

Module-III **12 Hrs**

Pre-Clinical Testing

Acute, sub-acute and chronic toxicity
Mutagenicity, teratogenecity and carcinogenicity
Effect on reproductive system
Bioassays

Module-IV **10 Hrs**

Drug Evaluation and Clinical Development

Phases of developmental clinical trials: Phase 0, Phase-I, Phase-II, Phase-III, Phase-IV
Placebo response, nocebo, advantages and disadvantages of placebo

Suggested Readings/Recommended Books (Latest Edition)

1. BE Blass, Basic Principles of Drug Discovery and Development, Academic Press, Elsevier.
2. D Wang and A Bakhai, Clinical Trials A Practical Guide to Design, Analysis, and Reporting, Remedica.
3. LD Edwards, AJ Fletcher, AW Fox, Principles and practice of Pharmaceutical Medicine, Wiley-Blackwell.
4. AA Rubin, M Dekker, New Drugs: Discovery and development, Wiley-Interscience.
5. SK Gupta, Basic Principles of Clinical Research and Methodology, Jaypee Brothers, Medical Publishers Pvt. Ltd.
6. SK Gupta, Drug Discovery and Clinical Research, Jaypee Brothers, Medical Publishers Pvt. Ltd.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 103-19	General Pharmacology	3	1	-	30	70	1.5	3	4

Pre-requisite: None

Co- requisite: None

Course Objectives: To develop essential understanding of molecular basis of drug action and relationship between drug dose and pharmacological action. The students will also learn about, adverse drug reactions and therapeutic monitoring of drugs.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basic concepts and signal transduction mechanisms of drugs
CO2	Comprehend the relationship between dose and pharmacological action in terms of therapeutic effect and toxic effect of drugs
CO3	Understand the basic pharmacokinetic parameters and their significance in drug development process
CO4	Understand the basic concepts of neurohumoral transmission and neurotransmitters involved in drug action
CO5	Understand the different types of adverse drug reactions and significance and methods of therapeutic drug monitoring

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	2	1	3	1	1	3	1	1
CO2	1	3	2	3	2	2	2	1	1
CO3	1	1	1	2	3	1	1	1	1
CO4	1	1	1	2	3	1	1	1	1
CO5	1	1	3	2	3	2	3	3	2

Module-I **09 Hrs**

Basic Pharmacokinetics
Drug passage across cell membranes

Order of reaction or process
Time course of drug concentration and effect
Absorption, distribution, metabolism and elimination of drugs
Bioavailability, presystemic elimination
Routes of drug administration

Module-II **14 Hrs**

Basic Pharmacodynamics

Mechanism of drug action: full agonist, partial agonist, inverse agonist, competitive antagonist, non-competitive antagonist
Dose response relationship, potency, efficacy, ED_{50}, LD_{50}, EC_{50}, LC_{50}, therapeutic index
Receptors, transduction process, second messengers
Tachyphylaxis
Chemical interactions (additive effect, potentiation, synergism)

Module-III **06 Hrs**

Special Topics

Adverse drug reactions (ADRs)
Drug interactions
Therapeutic Drug Monitoring

Module-IV **16 Hrs**

Autonomic Nervous System

General concepts- neurohumoral transmission, neurotransmitters
Cholinergic pharmacology
Adrenergic pharmacology

Suggested Readings/Recommended Books (Latest Edition)

1. BG Katzung AJ Trevor, Basic and Clinical Pharmacology, Mc Graw-Hill.
2. HP Rang, MM Dale, JM Ritter, RJ Flower, G Henderson, Rang & Dale's Pharmacology, Elsevier.
3. PN Bennett, MJ Brown and P Sharma, Clinical Pharmacology, Churchill Livingstone Elsevier.
4. KD Tripathi, Essentials of Medical Pharmacology, Jay Pee Medical.
5. PM Conn, Animal Models for the Study of Human Disease, Academic Press Elsevier.
6. FJ Hock, Drug Discovery and Evaluation: Pharmacological Assays, Springer.
7. MJ Derelanko and MA Hollinger, Handbook of Toxicology, Taylor & Francis.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 104-19	Clinical Research Lab I	-	-	4	30	20	3	3	2

Pre-requisite: None

Co- requisite: Fundamentals of Clinical Research (UC-MSCR102-19) & General Pharmacology (UC-MSCR103-19)

Course Objectives: To give students hands on training for preparing standard operating procedures and clinical trial protocols. To acquaint students with different routes of drug exposure and pre-clinical non-invasive techniques in drug testing.

Course Outcomes: At the end of the course, the student will be able to

CO1	Prepare standard drug solutions of various concentrations
CO2	Perform common biochemical test of clinical significance
CO3	Prepare clinical trial protocol
CO4	Perform validation and prepare standard operating procedures of laboratory equipments
CO5	Understand the different routes of drug administration and pre-clinical non-invasive techniques for drug testing

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	2	2	1	1	3	3	1
CO2	1	3	2	2	2	1	3	3	1
CO3	3	3	3	3	3	3	3	3	3
CO4	1	2	3	1	1	3	3	3	2
CO5	1	2	1	3	3	1	3	3	1

1. To prepare molar, molal and normal solutions
2. To prepare buffer solutions and determination of their pH
3. Validation of machines and analytical instruments
4. Extraction of DNA
5. Biochemical test: renal function test

6. Biochemical test: lipid profile
7. Preparation of manuals as per GLP for biochemical tests
8. Demonstration of routes of exposure/administration of drugs
9. Demonstration of some non – invasive techniques in preclinical screening of drug
10. Bioethics- do's and don'ts, confidentiality, cultural/social ethics
11. Preparation of SOPs for various equipments

Suggested Readings/Recommended Books (Latest Edition)

1. A.I. Vogel, Text Book of Quantitative Inorganic analysis, Pearson.
2. Shruti Mohanty and Aparna Verma, Practical Clinical Biochemistry, Jaypee Brothers Medical Publishers (P) Lt d.
3. Vijay Kumar and Kiran Dip Gill, Basic Concepts in Clinical Biochemistry: A Practical Guide, Springer
4. Kathleen Deska Pagana and Timothy J. Pagana, MOSBY'S Manual of Diagnostic and Laboratory Tests, Elsevier
5. D Wang and A Bakhai, Clinical Trials A Practical Guide to Design, Analysis, and Reporting, Remedica.
6. D Rosenbaum and M Dresser, Clinical Research Coordinator Handbook, CRC Press.
7. EDeRenzo, Writing Clinical Research Protocols: Ethical Considerations, Academic Press Elsevier.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 105-19	Professional Communication	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The objective of the course is to help the students become the independent users of English language.

Course Outcomes: At the end of the course, the student will be able to

CO1	Acquire basic proficiency in reading, comprehension and writing
CO2	Understand spoken and written English language, particularly the language of their chosen technical field
CO3	Produce on their own clear and coherent texts
CO4	Learn about the standard organization of the essay
CO5	Develop the skills to master in the writing formal e-mails and letters

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	2	1	2	3	1	3
CO2	3	3	1	2	1	3	3	1	3
CO3	2	1	3	1	2	2	1	1	3
CO4	1	1	2	1	1	2	2	1	3
CO5	3	1	3	1	1	1	1	1	3

Module-I **12 Hrs**

Reading

Long texts where the subject matter ranges from the descriptive and factual to the discursive and analytical (the texts taken should be from books, journals, magazines and newspapers). Reading extracts from books, magazines, newspapers, notices, advertisements, company handbooks and guidelines encounter on a daily basis in an English-speaking environment.

Module-II **14 Hrs**

Writing

Topics of general interest and suitable for candidates planning to work in Clinical Research Organisations

Describe, summarise or explain the information in own words based on a graph, table, chart or diagram. The writing would be based on the description and explanation of the given data, describe the stages of a process, flowchart of how something works or describe an object or event in a formal and academic style.

Essay writing in response to a point of view, argument or problem in a formal and academic style. Arguments should be supported by relevant examples.

Letter writing: requesting information or explaining a given situation.

Suggested Readings/Recommended Books (Latest Edition)

1. Practical English Usage. Michael Swan. OUP
2. Remedial English Grammar. F.T. Wood. Macmillan
3. On Writing Well. William Zinsser. Harper Resource Book
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
7. DL Plung and Tracy, Professional Communication: The Corporate Insider's Approach to Business Communication, South-Western College Pub
8. M Agarwal, Professional Communication, Krishna Prakashan Media (P) Ltd
9. NR Blyler, Professional Communication: The Social Perspective, SAGE Publications

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 111-19	Intellectual Property Rights	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is designed to sensitize students towards the significance of intellectual property laws in drug development process

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand of the core doctrines of intellectual property law
CO2	Understand the appropriate procedures for obtaining intellectual property protection
CO3	Describe the international treaties, conventions on IPR
CO4	Appreciate importance of compulsory licensing
CO5	Understand the patent infringement related issues

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	3	3	1	1	3	2	1
CO2	3	1	3	2	1	1	3	1	2
CO3	3	2	3	1	2	1	3	1	2
CO4	2	1	1	2	1	1	3	1	2
CO5	2	1	2	1	1	1	3	1	2

Module-I **12 Hrs**

General concepts Intellectual Property Rights & International Institutions

Intellectual Property overview and its theory
Requirement for Protecting Intellectual Property- a national and international comparison
Types of Intellectual Property- Origin and Development
World Intellectual Property Organization (WIPO)
Role of WIPO and its association with World Trade Organization (WTO)

Commercialization of Intellectual Property Rights by Licensing
Financial values of IPR

Module-II **12 Hrs**

Patent Laws Introduction to Copyrights and Trademarks

Indian Patent Law
The Patents Act, 1970 and its amendments
Criteria for Patentability
Filing Patent Applications and its Granting procedure
Patent Infringement
International Laws
Paris Convention and Patent Cooperation Treaty
WTO - TRIPS agreement
Indian copyright law, types of copyright
Types of trademarks, Indian trademark law

Suggested Readings/Recommended Books (Latest Edition)

1. IP Act & Rules from ipindia.nic.in
2. CDSO publications and updates of drug and Cosmetics act and rules (Govt. of India)
3. Kanfer , L. Shargel, Generic Product Development BE issued Publisher; Informa Healthcare
4. WTO; www.wto.org

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 112-19	Different Systems of Medicine	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To sensitize students regarding the importance of different systems of medicine that has played a crucial factor in meeting the global health care needs.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basic aspects about historical background, conceptual basis, different disciplines studied in the AYUSH.
CO2	Understand principles of prevention and treatment of diseases in alternative systems of medicine
CO3	Understand recent developments in the validation of different systems of medicine
CO4	Understand the use of medicinal plants and the utilization of different herbs in treatment of various ailments
CO5	Learn about drug manufacturing aspects and impact of globalization on Ayurveda

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	2	3	3	1	1	2	1
CO2	1	1	2	3	3	2	2	1	1
CO3	1	1	2	2	2	3	3	3	1
CO4	1	1	1	2	2	3	3	3	1
CO5	1	1	3	3	2	1	2	2	1

Module-I **12 Hrs**

Historical background of the different systems of medicines and different traditional practices

Principles of prevention and treatment of diseases in alternative systems of medicine

Uses of medicinal plants and the utilization of different herbs

Module-II **12 Hrs**

Medicinal plants and their different system of medicine
Recent developments in the validation of different systems of medicine
Regulations governing herbal drug development

Suggested Readings/Recommended Books (Latest Edition)

1. Marc Micozzi, Fundamentals of Complementary and Alternative Medicine, Elsevier
2. Arya Vaidya Sala, Medicinal Plants: A Compendium of 500 Species, Orient Blackswan Pvt Ltd. New Delhi
3. Mayo Clinic Book of Alternative Medicine & Home Remedies
4. www.fda.gov
5. www.ema.europa.eu
6. Ministry of AYUSH: Central Council for Research in Ayurvedic Sciences

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 113-19	Clinical Pharmacokinetics	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To sensitize students regarding significance of pharmacokinetic principles in new drug development.

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply pharmacokinetic information in clinical drug development
CO2	Contribute at planning, design and analysis of clinical studies, from pharmacokinetics perspective
CO3	Describe various types of variables that are used to measure and model drug effects
CO4	To use relevant clinical pharmacokinetic data to demonstrate the ability to determine doses of drugs in special patient populations
CO5	Understand significance of pharmacogenomics in clinical pharmacokinetics

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	3	3	1	2	1	1
CO2	3	1	1	3	3	1	1	2	1
CO3	3	1	1	1	1	1	1	1	1
CO4	3	1	1	2	3	1	2	1	1
CO5	2	1	1	3	2	1	1	1	1

Module-I **13 Hrs**

Basic Concepts

Clinical pharmacokinetic and pharmacodynamic concepts
Clinical pharmacokinetic equations and calculations
Pharmacogenomics in pharmacokinetics
Rational use of drug concentration measurements

Module-II **13 Hrs**

Drug Dosing in Special Populations

Renal and Hepatic Disease
Dialysis
Heart Failure
Obesity
Paediatric Patients
Therapeutic drug monitoring in geriatric patient

Suggested Readings/Recommended Books (Latest Edition)

1. Larry A. Bauer, Applied Clinical Pharmacokinetics, McGraw-Hill Companies, Inc.
2. John E. Murphy, Clinical Pharmacokinetics, American Society of Health-System Pharmacists.
3. Robin L. Southwood, Virginia H. Fleming, Gary Huckaby, Concepts in Clinical Pharmacokinetics, American Society of Health-System Pharmacists.
4. PN Bennett, MJ Brown and P Sharma, Clinical Pharmacology, Churchill Livingstone Elsevier.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 114-19	Alternatives in Toxicity Testing	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To provide the clear understanding of various regulations involving animal use and the various models of toxicity testing

Course Outcomes: At the end of the course, the student will be able to

CO1	Relate the toxicological findings in clinical safety
CO2	Support in selecting species
CO3	Sensitize students in selecting treatment regimen and designing subsequent non clinical toxicity studies
CO4	Animal ethics and regulatory requirements, CPCSEA guidelines
CO5	Concept of 4Rs (reduce, refine, replacement and rehabilitation)

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	2	2	2	1	1	1	1
CO2	1	1	2	2	2	2	1	1	1
CO3	1	1	2	2	2	2	1	1	1
CO4	1	2	2	1	1	1	1	2	1
CO5	1	1	1	1	1	1	1	1	1

Module-I **12 Hrs**

Animal ethics and regulatory requirements, CPCSEA guidelines
Concept of 4Rs (reduce, refine, replacement and rehabilitation)
Alternative models in toxicity testing (non-mammalian and non-animal models)

Module-II **12 Hrs**
ARRIVE guidelines: reporting of animal trials
QT interval screening in drug development

Examples of successful replacement: Draize test
Examples of successful replacement: Zebra fish
Examples of successful replacement: Drosophilae
Examples of successful replacement: *C. elegans*

Suggested Readings/Recommended Books (Latest Edition)

1. Frank A Barile, Principles of Toxicology Testing, CRC Press
2. Pal Grave, Animals and Alternatives in Toxicity Testing: Present Status and Future Prospects, Palgrave Macmillan

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 115-19	Fundamentals of Physiology	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To make students understand the basic physiology of human body. To improve the foundation of students for better understanding and comprehension of subject matters related to drug discovery, pre-clinical and clinical testing of drugs.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the anatomy and physiology of the systems of the human body
CO2	Appreciate the changes in normal physiology occurring in diseased states
CO3	Better understand the pharmacological principles involved in clinical testing of drug
CO4	Apply the understanding of functions of different parts of gastrointestinal tract in drug absorption and development of new drugs
CO5	Apply the knowledge of physiology of different organs in toxicity testing of drugs

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	3	3	1	2	1	1
CO2	1	1	2	3	2	2	2	2	1
CO3	1	1	2	3	3	3	2	3	3
CO4	1	1	2	3	2	2	2	1	1
CO5	1	1	2	3	2	3	2	2	1

Module-I

Smooth Muscles **02 Hrs**

Morphology, electrical and mechanical activity, molecular basis of contraction, relation of length to tension and plasticity.

Gastrointestinal System **05 Hrs**

Gross anatomy of the gastro-intestinal tract, functions of its different parts including those of liver, pancreas and gall bladder, various gastrointestinal secretions and their role in the absorption and digestion of food

Haemopoietic System **03 Hrs**

Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation.

Module-II

Cardiovascular System **05 Hrs**

Morphology, electrical properties of cardiac muscle, pacemaker tissue, basic anatomy of the heart, physiology of heart, blood vessels and circulation, cardiac cycle, heart sounds, cardiac cycle, blood pressure and its regulation

Central Nervous System **05 Hrs**

Basic anatomy and physiology of brain, spinal cord

Endocrine System **06 Hrs**

Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenals, pancreas, testes and ovary, their hormones and functions

Suggested Readings/Recommended Books (Latest Edition)

1. A Waugh and A Grant, Ross and Wilson Anatomy and Physiology in Health and Illnes, Churchill Livingstone Elsevier
2. K E Barrett, SM Barman, S Boitano, H Brooks, Ganong's Review of Medical Physiology, Lange
3. AC Guyton, JE. Hall, Guyton and Hall Textbook of Physiology, Saunders-Elsevier

Course Code	Course Title	Teaching Load			Marks		Exam	Credits
		L	T	P	Int.	Ext.	Internal	
UC-MSCR 106-19 UC-MSCR 206-19 UC-MSCR 307-19	Journal Club	-	-	4	50	-	Continuous Mode	2

Pre-requisite: None

Co- requisite: Professional Communication (UC-MSCR 105-19), Professional Communication Lab (UC-MSCR 204-19), ICT Skills Lab (UC-MSCR 305-19)

Course Objectives: The course is designed to instil an analytical temperament in the students for critical review of the existing literature and better understanding of clinical research.

Course Outcomes: At the end of the course, the student will be able to

CO1	Critically review the literature
CO2	Develop an approach to analyse the various types of articles
CO3	Become familiar with sources of bias and types of study designs
CO4	Comprehend how results of study are clinically significant
CO5	Demonstrate skill in scientific communication both orally and in writing

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	3	3	2	2	3	2	1
CO2	2	1	3	3	3	3	3	2	1
CO3	2	1	1	2	2	3	3	2	1
CO4	2	1	2	2	3	3	3	2	1
CO5	1	1	1	1	1	1	1	1	3

Instructions

1. Students are to work with assigned mentor to chose and analyze an appropriate article followed by a power point presentation.
2. Power-point presentations should be organized as follows: 10 minutes background, 10 minutes article 15 minutes analysis 5 minutes discussion
3. Students are encouraged to critically appraise the literature, and develop their own independent criticisms

SECOND SEMESTER

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 201-19	Pharmacotherapeutics-1	3	1	-	30	70	1.5	3	4

Pre-requisite: General Pharmacology (UC-MSCR 103-19)

Co- requisite: None

Course Objectives: The course is designed to introduce to the learners about the common diseases and effect of target drugs on human body system. The aim would be to introduce the pharmacological basis of treatment.

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop an understanding of the basic concepts of common diseases prevalent in the society
CO2	Apply their knowledge and understanding of the pathophysiology and management (pharmacological and non-pharmacological) of diseases
CO3	Choose and justify appropriate drug and treatment duration to a given patient with regard to current recommendations and patient-related factors such as other diseases, age, organ functions and other drug treatment
CO4	Integrate pharmacology, pathophysiology, pharmacodynamic, pharmacokinetics and other biomedical and pharmaceutical sciences as they pertain to clinical therapeutics of certain disorders
CO5	Identify the need for further knowledge and formulate relevant learning outcomes

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	2	3	3	2	1	1
CO2	1	2	1	3	1	2	3	1	1
CO3	1	1	3	1	1	1	3	1	1
CO4	2	3	3	3	3	2	1	3	1
CO5	2	3	3	2	3	2	2	2	3

Module-I **12 Hrs**

Basic Concepts

Quality of Life and Pharmacotherapy

Measuring Quality of Life
Pharmacogenetics
Paediatrics- ADME, factors affecting paediatric drug therapy, issues in paediatric drug therapy
Geriatrics- Epidemiology of Aging, Human Aging and Changes in Drug Pharmacokinetics and Pharmacodynamics, Altered Pharmacokinetics, Clinical Geriatrics, Provision of Comprehensive Geriatric Assessment
Pharmacoepidemiology- limits of knowledge at the time of new drug approval, role of the FDA and pharmacoepidemiology
Clinical Toxicology

Module-II **12 Hrs**

Neurologic and Psychiatric Disorders

Etiology, Pathophysiology and Pharmacotherapy of Neurologic Illness – Depression; Epilepsy; Mania; Pain; Schizophrenia; Alzheimer's disease; and Parkinson's disease

Module-III **12 Hrs**

Gastrointestinal Disorders

Etiology, Pathophysiology and Pharmacotherapy of Gastrointestinal illness- Gastroesophageal Reflux Disease; Inflammatory Bowel Disease; Drug-Induced Liver Disease; Pancreatitis

Module-IV **12 Hrs**

Cardiovascular Disorders

Etiology, Pathophysiology and Pharmacotherapy of cardiovascular illness - Hypertension, Ischemic Heart Disease, Congestive Heart Failure, Venous Thromboembolism, Hyperlipidaemia

Suggested Readings/ Books

1. Pharmacotherapy: A Pathophysiologic Approach. Di Piro JT (Eds) New York, NY, The Mc-Graw Hill Co., Inc
2. L.Y. Young MAK-K, et.al., (Eds). Applied Therapeutics: Clinical Use of Drugs. Vancouver: Applied Therapeutics, Inc
3. Textbook of Therapeutics: Drug and Disease Management, Eighth Edition edited by Richard A. Helms
4. Pharmacotherapy Principles and Practice. Chishlom-Burns (Eds). NewYork, The Mc Graw-Hill Co., Inc
5. Clinical Pharmacy and Therapeutics. Roger Walker and Cate Whittlesea (Eds). Churchill Livingstone Elsevier
6. Virginia Poole Arcangelo, Andrew M. Peterson, Veronica Wilbur, Jennifer A. Reinhold, Pharmacotherapeutics for Advanced Practice: A Practical Approach, Wolters Kluwer Health

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 202-20	Clinical Research Regulations & Ethics	3	1	-	30	70	1.5	3	4

Pre-requisite: Fundamentals of Clinical Research (UC-MSCR102-19)

Co- requisite: Clinical Research Lab II (UC-MSCR203-19)

Course Objectives: To educate the students about drug regulatory affairs and significance of regulatory guidelines in drug development and marketing

Course Outcomes: At the end of the course, the student will be able to

CO1	Comprehend clinical trial regulations and appreciate their importance
CO2	Understand the practical use and evolution of these regulations
CO3	Be familiar with the documents required to be compiled for an ethical & regulatory clinical trial application
CO4	Appreciate the importance of quality system and SOPS
CO5	Make comparison between the regulatory guidelines applicable in different regions

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	3	1	1	1	2	3	1
CO2	2	1	3	1	1	1	2	3	1
CO3	3	3	3	1	1	2	2	3	1
CO4	3	3	2	2	1	2	1	3	1
CO5	1	1	3	1	1	2	3	3	1

Module-I **09 Hrs**

Evolution of Regulatory Control

European Medicines Agency (EMA)

Vaccine Act, Biological Control Act, Pure food drugs act, Food and Drug Administration (FDA), Kefauver Harris amendments act, Waxman Hatch act, Code of federal regulations, Prescription Drug User Fee Amendments (PDUFA)

International Council for Harmonisation (ICH)

Drugs and cosmetic act 1945

Module-II **13 Hrs**

Regulatory Aspects of Different Regions

Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Paper NDA
Market authorization holders (MAH), its procedures
Regulation of medical devices
Regulation of vaccines
Safety Report filing
Regulation of Complementary Medicine
Regulation of non-prescription drugs

Module-III **14 Hrs**
Regulatory Guidelines

International Conference on Harmonization (ICH) GCP guidelines
Overviews of good laboratory practice (GLP)
Schedule Y of Indian Drugs and Cosmetic Act, New Drugs and Clinical Trials Rules (2019)
Basic regulation of bioavailability/ bioequivalence (BA/BE) studies

Module-IV **09 Hrs**
Ethics in Clinical Research

Evolution of ethics in clinical research: Thalidomide disaster, Tuskegee experiment, Nuremberg Code, Declaration of Helsinki, Belmont report
Establishment of Council for International Organizations of Medical Sciences (CIOMS), National Institutes of Health (NIH) and Indian Council of Medical Research (ICMR) guidelines
Compensation to subjects/patients for clinical trial related injuries

Suggested Readings/Recommended Books (Latest Edition)

1. John. P. Griffin, Textbook of Pharmaceutical Medicine, Wiley Blackwell
2. John I, Gallin, Principles and Practice of Clinical research, Academic Press
3. Ira R. Berry, Robert P. Martin, The Pharmaceutical Regulatory Process, Publisher; Informa Healthcare
4. Guidelines: Drugs and Cosmetics Act, EMA
5. www.ich.org
6. www.fda.gov
7. Central Drugs Standard Control Organization: www.cdsco.gov.in
8. SK Gupta, Drug Discovery and Clinical Research, Jaypee Brothers, Medical Publishers Pvt. Ltd.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 203-19	Clinical Research Lab II	-	-	4	30	20	1.5	3	4

Pre-requisite: Fundamentals of Clinical Research (UC-MSCR102-19)

Co- requisite: Clinical Research Regulations (UC-MSCR 202-20)

Course Objectives: The course is designed to impart practical knowledge to students about the various aspects of clinical research in accordance to GCP, GLP and clinical trial regulations

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the practical application of clinical trial regulations for conduct of clinical trials
CO2	Trained about the sample collection and analysis and interpretation of lab data in compliance with GLP
CO3	Develop SOPs and various documents required for conduct of quality clinical studies
CO4	Apply GCP in collection of clinical data
CO5	Appreciate the significance of statistical analysis in clinical research

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	3	2	2	1	1	2	1
CO2	2	1	2	2	3	3	1	1	2
CO3	3	2	2	3	2	2	3	2	1
CO4	2	2	2	3	3	3	2	3	1
CO5	3	1	1	3	2	2	3	2	2

1. Measurement of pulse rate and body temperature
2. Effect of exercise on blood pressure
3. Biochemical tests: protein estimation by Lowry's method
4. Biochemical tests: liver function test
5. Biochemical tests: blood glucose

6. Demography: assessment of age, sex, height, weight, waist, BMI, smoking, educational attainment, area-based measure (eg. index of deprivation or disadvantage, rurality distance from health centres etc)
7. Application of simple statistical test to the results obtained in above experiments
8. Haematology tests: haemoglobin, total leukocyte count, differential leukocyte count, erythrocyte sedimentation rate
9. Interpreting Electrocardiography (ECG)
10. Case studies solutions
11. Summary of Product Characteristics (SmPC) development

Suggested Readings/Recommended Books (Latest Edition)

1. Shruti Mohanty and Aparna Verma, Practical Clinical Biochemistry, Jaypee Brothers Medical Publishers (P) Lt d.
2. Vijay Kumar and Kiran Dip Gill, Basic Concepts in Clinical Biochemistry: A Practical Guide, Springer
3. Kathleen Deska Pagana and Timothy J. Pagana, MOSBY'S Manual of Diagnostic and Laboratory Tests, Elsevier
4. John G. Brock-Utne, Clinical Research: Case Studies of Successes and Failures, Publisher; Springer.
5. Duolao Wang and Ameet Bakhai, Clinical Trials: A Practical Guide to Design, Analysis, and Reporting, Remedica
6. Guidelines: ICH, USFDA, Drugs and Cosmetics Act, EMA
7. Electronic Medicines Compendium (eMC): https://www.medicines.org.uk/emc/

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 204-19	Professional Communication Lab	-	-	4	30	20	3	3	2

Pre-requisite: Professional Communication Theory Course

Co- requisite: None

Course Objective: The objective of the course is to help the students become the independent users of English language.

Course Outcomes: At the end of the course, the student will be able to

CO1	Acquire basic proficiency in listening and speaking English language
CO2	Understand spoken and written English language, particularly the language of their chosen technical field
CO3	Produce on their own clear and coherent texts
CO4	Develop the skills to communicate in English language with clients at work place
CO5	Identify the need for further knowledge and formulate relevant learning outcomes

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	2	3	3	2	1	1
CO2	1	2	1	3	1	2	3	1	1
CO3	1	1	3	1	1	1	3	1	3
CO4	2	3	3	3	3	2	1	3	1
CO5	2	3	3	2	3	2	2	2	1

Module-I **12 Hrs**

Listening English

A conversation between two people set in an everyday social context, e.g. a conversation in an accommodation agency

A monologue set in an everyday social context, e.g. a speech about local facilities
A conversation between up to four people set in an educational or training context, e.g. a tutor and a student discussing an assignment
A monologue on an academic subject, e.g. a classroom lecture

Module-II **12 Hrs**

Speaking English

Candidates will be asked to answer general questions about themselves and a range of familiar topics, such as their home, family, work, studies and interests. This activity lasts between 4 and 5 minutes
Candidates will be given a minute to prepare their thoughts on an assigned topic, before being invited to speak for up to two minutes. The examiner will then ask one or two questions on the same topic to finish this part of the test
Candidates will be asked further questions connected to the topic in Part 2. These questions will provide an opportunity to discuss more abstract issues and ideas. This part lasts between four and five minutes

Suggested Books/ Manuals

1. Listen Here! Intermediate Listening Activities; Clare West; Georgian Press and Cambridge University Press
2. Skillful Foundation Level Listening & Speaking Digital Student's Book Pack; Macmillan Education

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 205-20	Medical Writing	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objective: The course is designed to explore the basic skills of medical writing. Medical writing is an essential part of clinical research and drug development programme. The goal of this module is to provide overview in both medical science and writing fundamentals.

Course Outcomes: At the end of the course, the student will be able to

CO1	Improve medical writing skills and better understanding the biomedical publication process
CO2	Demonstrate writing, reading, editing, and reviewing skills
CO3	Become ready to be absorbed Professionals
CO4	Understand about clinical research and the latest techniques and trends in the industry
CO5	Understand career prospects in the medical writing

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	2	2	2	3	1	1
CO2	1	2	1	2	1	2	2	1	3
CO3	3	2	3	1	1	1	3	1	3
CO4	2	3	3	3	3	2	1	3	1
CO5	2	3	3	2	2	2	2	2	2

Module-I **12 Hrs**

Introduction to Medical writing and Healthcare Communication
The Writing Process: prewriting strategies and steps in writing process
Online search techniques
Rules of writing: basic structure of write up; plagiarism and copyrights

Module-II **12 Hrs**

Scientific Writing: writing case reports, drug monograph and abstract writing
Regulatory writing: medical writing in clinical research, study design, observational studies, experimental studies
ICH-E3: structure and content of clinical study reports
Common Technical Document: Format of dossier, eCTD

Suggested Readings/ Books

1. Medical Writing: A Guide for Clinicians, Educators, and Researchers, Springer
2. The Complete Guide to Medical Writing by Mark C. Stuart, Mark Stuart Pharmaceutical Press
3. Guidelines for Reporting Health Research by David Moher Doughlas Altman BMJ books
4. Medical writing a good practice guide by Justina-Orleans; Wiley-Blackwell
5. Successful scientific writing: a step-by-step guide for the biological and medical sciences, Cambridge University Press.
6. ICH: https://www.ich.org

Suggested Software

1. MS Office especially the subscription-based Office 365.
2. Google Docs
3. Scrivener
4. ReadCube
5. Endnote
6. RefMan
7. PerfectIt3 (and PerfectIt Pro)
8. Medical spellcheckers: (Spellex and Stedman's)
9. Dragon Naturally Speaking
10. Statistical analysis: R, SAS, MS SQL Server
11. Adobe Creative Cloud (Acrobat, Photoshop, Audition, etc)

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 211-19	Fundamentals of Epidemiology	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To cover concepts of molecular epidemiology and its applications in effective clinical outcome

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand measures of disease occurrence and disease association, mortality indicators and morbidity indicators
CO2	Understand different mechanisms of bias in clinical research
CO3	Implicate evidence-based clinical medicine, including the specifications of diagnostic tests, screening tests, and prognostic tests
CO4	Interpret and assess the genetic measures in research
CO5	Understand the significance of pharmacogenomics in clinical research

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	2	1	1	2	2	2	1	1
CO2	1	1	1	2	2	2	2	1	2
CO3	1	2	1	1	1	2	1	1	1
CO4	1	2	1	1	2	1	1	2	1
CO5	1	2	1	1	1	1	2	1	1

Module-I **13 Hrs**

Measures of disease occurrence and disease association

Mortality indicators and morbidity indicators

The different mechanisms of bias in clinical research (study, response, information, interviewer, site selection, measurement, and confounding); and a conceptual approach to multivariable analysis

Instruction in the research implications of evidence-based clinical medicine, including the specifications of diagnostic tests, screening tests, and prognostic tests
Pharmacoepidemiological studies
Calculation of relative risk and odds ratio

Module-II **13 Hrs**

Introduction to the concepts, principles, and use of molecular and genetic methods in epidemiology and clinical research
Human Genome Project
Framework for interpreting, assessing, and incorporating molecular and genetic measures in research
Meaning of race, ethnicity, social class, and culture, their effects on the conduct and interpretation of clinical research
Pharmacogenomics and its application in clinical research, genome-wide association study (GWAS)

Suggested Readings/Recommended Books (Latest Edition)

1. David Duncan Collier, Epidemiology: Basis for Disease Prevention and Health Promotion, Macmillan Publishers.
2. Robert H. Fletcher and Suzanne W. Fletcher, Clinical Epidemiology: The Essentials, WHO Press
3. Brian MacMahon and Thomas F Pugh, Epidemiology Principles and methods, Lippincot William and Wilkins
4. Japhet Killewo, Epidemiology and Demography in Public Health, Elsevier

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 212-19	International Regulatory Affairs	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is designed to impart advanced knowledge and skills required to learn the concept of various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the regulatory guidance's and guidelines for filing and approval process applicable in different regions
CO2	Participate as an effective member in pharmaceutical regulatory affairs team
CO3	Understand preparation of dossiers and their submission to regulatory agencies in different countries
CO4	Understand clinical trials requirements for approvals for conducting clinical trials
CO5	Make comparison between the regulatory guidelines applicable in different regions

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	3	1	1	1	2	1	2
CO2	3	1	1	1	1	2	2	1	1
CO3	3	1	3	2	1	1	2	2	2
CO4	3	1	3	2	2	1	2	3	1
CO5	1	1	3	1	1	2	3	3	1

Module-I **12 Hrs**

Introduction to regulatory bodies

Organisation for Economic Co-operation and Development (OECD)
Brazilian Health Surveillance Agency (ANVISA)
Therapeutic Goods Administration (TGA)

Pharmaceuticals and Medical Devices Agency (PMDA)

Module-II **12 Hrs**

Introduction to regulatory bodies

Gulf Co-Operation Council: Central Drug Registration
New Zealand Medicines and Medical Devices Safety Authority (Medsafe)
Health Canada
South African Health Products Regulatory Authority (SAHPRA)
Ministry of Health of the Russian Federation

Suggested Readings/Recommended Books (Latest Edition)

1. Ira R. Berry and Robert P. Martin, The Pharmaceutical Regulatory process, Drugs and the Pharmaceutical Sciences, Informa Health Care
2. Richard A Guarino, New Drug Approval Process: Accelerating Global Registrations Drugs and the Pharmaceutical Sciences
3. Sandy Weinberg, Guidebook for drug regulatory submissions, John Wiley & Sons.lnc.
4. https://www.sahpra.org.za/
5. https://www.tga.gov.au/
6. https://www.pmda.go.jp/
7. https://www.canada.ca/en/services/health/drug-health-products.html
8. http://portal.anvisa.gov.br/english
9. http://ghc.sa/en-us/pages/centraldrugregistration.aspx
10. https://www.medsafe.govt.nz/
11. https://www.oecd.org/chemicalsafety/

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 213-19	Biostatistics in Clinical Research	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is designed to impart ability to think critically about data, make valid inferences, and understand how statisticians are an essential element of clinical investigations

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply an appropriate statistical test
CO2	Demonstrate skills in the analysis of clinical research data
CO3	Demonstrate skills in interpreting and communicating the results of statistical analysis, orally and in writing
CO4	Acquire practical understanding of parametric and nonparametric assumptions and tests
CO5	Understand and apply statistical considerations when preparing a protocol

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	2	3	3	2	1	1
CO2	3	1	1	2	3	3	3	2	1
CO3	3	1	1	2	3	3	3	1	3
CO4	2	1	1	2	3	3	1	1	1
CO5	3	1	1	3	2	2	3	2	1

Module-I **12 Hrs**

Types of data and its analysis (categorical *vs* quantitative)
Organization of data, distribution of data and calculation of central tendencies
Confidence interval, SD, SE, regression and correlation
Comparison of data between different groups: using null hypothesis and test of significance (paired t-test, unpaired t-test, Analysis of variance (ANOVA), Analysis of covariance (ANCOVA)

Module-II **12 Hrs**

Comparison of data between different groups: Coefficient of Variation, chi-square test, Fischer exact, Mann-Whitney, Wilcoxon, McNemar test, Kruskal Wallis
Intention-to-treat (ITT) and Per-protocol (PP) and Treatment-received (TR) analyses of results in clinical research, sample size calculation
Introduction to common statistical software packages used in clinical research (e.g. SAS, SPSS)

Suggested Readings/Recommended Books (Latest Edition)

1. Geoffrey R. Norman, David L. Streiner, Biostatistics: The Bare Essentials, Publisher; PMPH USA
2. Beth Dawson, Robert G. Trapp, Basic & Clinical Biostatistics, Publisher; McGraw-Hill
3. Marcello Pagano, Kimberlee Gauvreau, Principles of Biostatistics, Publisher; CRC Press
4. Antonella Bacchieri, Giovanni Della Cioppa, Fundamentals of Clinical Research, Publisher; Springer
5. Katsumi Kobayashi, K. Sadasivan Pillai, A Handbook of Applied Statistics in Pharmacology, Publisher; CRC Press

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 214-19	Poisoning and Management	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is designed to provides the understanding on the general concepts and the various types of drug poisoning and its management

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the general concepts of poisoning
CO2	Identify various types of poisoning
CO3	Understand toxicology of heavy metals
CO4	Learn about treatment and management of poisoning
CO5	Understand the science of chelating agents

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	1	1	2	2	1	1	1	1
CO2	1	2	2	1	1	1	1	1	1
CO3	1	2	2	1	1	1	1	1	1
CO4	1	2	2	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1

Module-I **12 Hrs**

General concepts and some common types of drug poisoning

Introduction to science of poisons, pollutants, industrial solvents etc.

Poisoning and its types

Some common poisoning: atropine poisoning, paracetamol, aspirin, organophosphorous compounds, barbiturates, cyanides, benzodiazepines, methyl alcohol, digoxin, opioids

Management of poisoning: general measures and treatment of poisoning poison control/information centre's

Module-II **12 Hrs**

Heavy metal poisoning and its management

Toxicology of heavy metals: mercury, lead, arsenic, iron

Chelating agents: dimercaprol, succimer, unithol, edentate calcium disodium (EDTA), d-penicillamine

Suggested Readings/Recommended Books (Latest Edition)

1. Andrew L. Reeves, Toxicology: Principles And Practice, Wiley Blackwell
2. Raymond Niesink and Mannfred A. Hollinger, Toxicology: Principles and Applications, American Chemical Society
3. Frank A. Barile, Barile's Clinical Toxicology: Principles and Mechanisms, CRC Press
4. Bev-Lorraine True, Dreisbach's Handbook of Poisoning: Prevention, Diagnosis and Treatment, CRC Press

Course Code	Course Title	Teaching Load			Marks		Exam	Credits
		L	T	P	Int.	Ext.	Internal	
UC-MSCR 106-19 UC-MSCR 206-19 UC-MSCR 307-19	Journal Club	-	-	4	50	-	Continuous Mode	2

Pre-requisite: None

Co- requisite: Professional Communication (UC-MSCR 105-19), Professional Communication Lab (UC-MSCR 204-19), ICT Skills Lab (UC-MSCR 305-19)

Course Objectives: The course is designed to instil an analytical temperament in the students for critical review of the existing literature and better understanding of clinical research.

Course Outcomes: At the end of the course, the student will be able to

CO1	Critically review the literature
CO2	Develop an approach to analyse the various types of articles
CO3	Become familiar with sources of bias and types of study designs
CO4	Comprehend how results of study are clinically significant
CO5	Demonstrate skill in scientific communication both orally and in writing

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	3	3	2	2	3	2	1
CO2	2	1	3	3	3	3	3	2	1
CO3	2	1	1	2	2	3	3	2	1
CO4	2	1	2	2	3	3	3	2	1
CO5	1	1	1	1	1	1	1	1	3

Instructions

1. Students are to work with assigned mentor to chose and analyze an appropriate article followed by a power point presentation.
2. Power-point presentations should be organized as follows: 10 minutes background, 10 minutes article 15 minutes analysis 5 minutes discussion
3. Students are encouraged to critically appraise the literature, and develop their own independent criticisms

THIRD SEMESTER

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 301-19	Pharmacotherapeutics-II	3	1	-	30	70	1.5	3	4

Pre-requisite: Pharmacotherapeutics-I (UC-MSCR 201-19)

Co- requisite: None

Course Objectives: The course is designed to introduce to the learners about the common diseases and effect of target drugs on human body system. The aim would be to introduce the pharmacological basis of treatment.

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop an understanding of the basic concepts of common diseases prevalent in the society
CO2	Apply their knowledge and understanding of the pathophysiology and management (pharmacological and non-pharmacological) of diseases
CO3	Choose and justify appropriate drug and treatment duration to a given patient with regard to current recommendations and patient-related factors such as other diseases, age, organ functions and other drug treatment
CO4	Integrate pharmacology, pathophysiology, pharmacodynamic, pharmacokinetics and other biomedical and pharmaceutical sciences as they pertain to clinical therapeutics of certain disorders
CO5	Identify the need for further knowledge and formulate relevant learning outcomes

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	3	3	2	3	3	2	1	1
CO2	1	2	1	3	1	2	3	1	1
CO3	1	1	3	1	1	1	3	1	1
CO4	2	3	3	3	3	2	1	3	1
CO5	2	3	3	2	3	2	2	2	3

Module-I **12 Hrs**

Endocrine System Disorders

Etiology, Pathophysiology and Pharmacotherapy: diabetes mellitus, thyroid disorders,

obesity
Infertility and antifertility drugs

Module-II **12 Hrs**

Therapeutics in Infectious Diseases

Gastro-intestinal infections, urinary tract infections
Fungal infections
Protozoal and viral infections (HCV, H1N1, rotavirus)
HIV and its management

Module-III **12 Hrs**

Respiratory System Disorders

Etiology, Pathophysiology and Pharmacotherapy: bronchial asthma, chronic obstructive pulmonary disease (COPD), pulmonary hypertension, tuberculosis

Module-IV **12 Hrs**

Cancer therapeutics: chemotherapy
Arthritis: osteoarthritis, rheumatoid arthritis
Drugs avoided during pregnancy and lactation

Suggested Readings/ Books (Latest Edition)

1. Pharmacotherapy: A Pathophysiologic Approach. Di Piro JT (Eds) New York, NY, The Mc-Graw Hill Co., Inc
2. L.Y. Young MAK-K, et.al., (Eds). Applied Therapeutics: Clinical Use of Drugs. Vancouver: Applied Therapeutics, Inc
3. Textbook of Therapeutics: Drug and Disease Management, Eighth Edition edited by Richard A. Helms
4. Pharmacotherapy Principles and Practice. Chishlom-Burns (Eds). NewYork, The Mc Graw-Hill Co., Inc
5. Clinical Pharmacy and Therapeutics. Roger Walker and Cate Whittlesea (Eds). Churchill Livingstone Elsevier
6. Virginia Poole Arcangelo, Andrew M. Peterson, Veronica Wilbur, Jennifer A. Reinhold, Pharmacotherapeutics for Advanced Practice: A Practical Approach, Wolters Kluwer Health

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 302-20	Clinical Study Design	3	1	-	30	70	1.5	3	4

Pre-requisite: Fundamentals of Clinical Research (UC-MSCR102-19)

Co- requisite: None

Course Objectives: The course is designed to provide opportunity to students to learn about regulatory and scientific rationale of designing, conducting, and successfully completing a clinical trial.

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop an understanding of the basic concepts of different types of clinical study designs
CO2	Apply their knowledge and understanding in choosing the appropriate study design
CO3	Understand the key study design elements for preventing bias
CO4	Understand what are the essential documents required to conduct a clinical trial
CO5	Learn about the trial design for special population

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	1	2	2	3	1	3	1
CO2	3	1	1	2	2	3	2	3	1
CO3	3	1	1	1	1	3	2	3	1
CO4	3	1	3	1	1	1	1	2	1
CO5	3	1	2	2	3	1	2	3	1

Module-I **12 Hrs**

Inclusion and exclusion criteria
Screening and recruitment of subjects
Methods of randomization, blinding
Placebo
Endpoints: primary, secondary, composite, surrogate

Module-II **12 Hrs**

Type of Studies

Observational studies: case report, case series, cross-sectional studies, case control study, cohort study, relative risk and odds ratio

Experimental studies: randomized trial, open label study, cross over, equivalence trials, superiority trials and non-inferiority trials

Module-III **12 Hrs**

Phases of clinical trials

Designing phase I, II, III and IV trials: design types (dose ranging, safety studies, proof of concept studies, cluster randomized, factorial design, sequential design), their characteristics, and parameter to measure

Module-IV **12 Hrs**

Trial designs of common diseases like CVS (anti-hypertensive drugs), CNS (neurodegenerative diseases), cancer and metabolic disorders

BA-BE study designs

Trials for special population: paediatric, geriatric, pregnant women and lactating women

Suggested Readings/ Books (Latest Edition)

1. Stephen B. Hulley, Steven R. Cummings, Warren S. Browner, Deborah G. Grady and Thomas B. Newman, Designing Clinical Research, Lippincott Williams and Wilkins
2. Duolao Wang and Ameet Bakhai, Clinical Trials: A Practical Guide to Design, Analysis, and Reporting, Remedica
3. Shein-Chung Chow, Design and Analysis of Bioavailability and Bioequivalence Studies, CRC Press
4. Stephen P. Glasser, Essentials of Clinical Research, Springer
5. Beth Dawson, Robert G. Trapp, Basic and Clinical Biostatistics, Publisher; McGraw-Hill
6. Richard Chin and Bruce Y. Lee, Principles and Practice of Clinical Trial Medicine, Academic Press
7. John I. Gallin, Frederick P. Ognibene, Laura Lee Johnson, Principles and Practice of Clinical Research, Academic Press.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 303-19	Research Methodology	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: Clinical Study Design (UC-MSCR 302-20)

Course Objectives: The course is designed to provide opportunity to students to learn about some basic concepts of research and its methodologies.

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop an understanding of the basic concepts of research methodologies
CO2	Apply their knowledge and understanding in defining specific research problems
CO3	Develop an understanding about different research designs
CO4	Differentiate between primary and secondary data and significance of each type of data
CO5	Understand the basics of writing and presenting scientific data

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	2	1	3	2	1	1
CO2	2	1	1	1	3	1	2	2	1
CO3	2	1	1	1	1	2	2	2	1
CO4	2	1	1	1	1	1	3	1	1
CO5	3	1	1	1	1	2	3	3	3

Module-I **12 Hrs**

Definition, general and specific characteristics of research, classification, types and objective of research, research process, criteria of good research, basic concept of experiments and research, significance of research

Planning and designing a research study: choosing a research topic, literature review, research problem formulation articulating hypothesis, selection of variables, research participants

Module-II **12 Hrs**

Meaning, nature and types of data: primary and secondary; observational; experimental
Data Collection: types of sampling design
Experimental designs, quasi-experimental designs, non-experimental or qualitative designs
Art of scientific writing: Steps to better writing, flow method, organization of material and style, drawing figures, graphs, tables, footnotes, references etc. in a research paper
Levels of Evidence for Clinical Studies
Meta-analysis

Suggested Readings/ Books (Latest Edition)

1. Geoffrey Marczyk, David DeMatteo, David Festinger;.Essential of Research Design and Methodology. John Wiley & Sons
2. Kothari, C.R; Research Methodology: Methods and Techniques.. New Age International Publishers, New Delhi
3. Beth Dawson, Robert G. Trapp, Basic and Clinical Biostatistics, Publisher; McGraw-Hill

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 304-19	Pharmacovigilance	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: This course focuses on importance of drug safety issues that have potential to affect public health.

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop an understanding of early detection of new adverse reactions and to introduce measures to manage those risks
CO2	Define and classify ADRs, detection, reporting and causality assessment
CO3	Demonstrate basic tools used in pharmacovigilance safety studies
CO4	Develop practical understanding of signal detection and communication of safety signals with stakeholders
CO5	Understand drug monitoring, risk management studies and apply statistical considerations when preparing a protocol

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	2	2	3	1	1	1	2
CO2	3	1	1	2	2	1	1	1	2
CO3	3	1	1	2	2	1	1	1	3
CO4	2	2	2	2	1	1	1	1	1
CO5	3	1	1	1	2	1	1	2	1

Module-I **12 Hrs**

Introduction to Pharmacovigilance
Definition and classification of ADRs, Detection, reporting and causality assessment
Pharmacovigilance in India and global perspective
Pharmacovigilance methods, passive surveillance-spontaneous reports and case series, Active surveillance-drug event monitoring and registries

Basic tools used in pharmacovigilance, Safety studies, Importance of pharmacovigilance

Module-II **12 Hrs**

Pharmaceutical preparations (Adverse effects), product surveillance and post marketing
Signal detection and follow-up
Communicating safety signals with stakeholders, Erice Declaration, Risk management studies
Introduction to translational medicine, drug monitoring, pharmacovigilance in drug regulation
Overview of various software used in pharmacovigilance
Introduction to artificial intelligence in pharmacovigilance
Introduction to herbavigilance
Introduction to materiovigilance

Suggested Reading/ Recommended Books (Latest Edition)

1. Brian L. Storm and Stephen K. Kimmel, Textbook of Pharmacoepidemiology, Wiley Blackwell
2. Ronald D. Mann, Elizabeth Andrews, Pharmacovigilance, Wiley Blackwell
3. Andrew Bate, Evidence-Based Pharmacovigilance, Human Press
4. Patrick Waller, Mira Harrison-Woolrych, An Introduction to Pharmacovigilance, Wiley-Blackwell
5. Uppsala Monitoring Centre: https://www.who-umc.org/

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 305-19	Clinical Research Lab III	-	-	4	30	20	1.5	3	2

Pre-requisite: Fundamentals of Clinical Research (UC-MSCR102-19) and Clinical Research Regulations & Ethics (UC-MSCR 202-20)

Co- requisite: Clinical Study Design (UC-MSCR302-19)

Course Objectives: The course is designed to impart practical knowledge to students about the various aspects of clinical research in accordance to GCP, GLP and clinical trial regulations

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the practical application of clinical trial regulations for conduct of clinical trials
CO2	Develop SOPs and various documents required for conduct of quality clinical studies
CO3	Develop various documents essential in clinical research
CO4	Develop clinical study protocols
CO5	Comprehend the significance of documentation in clinical research

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	3	2	2	1	1	2	1
CO2	3	2	2	3	2	2	3	2	1
CO3	3	1	2	2	2	2	2	3	2
CO4	3	1	1	3	2	2	2	3	2
CO5	3	1	1	1	1	1	2	3	1

1. Development of clinical research documents: SOPs development
2. Development of clinical research documents: investigator brochure
3. Development of clinical research documents: informed consent forms
4. Development of clinical research documents: case record form
5. Development of clinical research documents: preparation of dummy problem-based protocol clinical research protocol

6. Development of clinical research documents: preparation of dummy bioequivalence protocols
7. Preparation of a clinical trial protocol for submission to regulatory agency
8. How to take case history
9. Mock Case report – Causality assessment
10. Use of software used in clinical research

Suggested Readings/Recommended Books (Latest Edition)

1. John G. Brock-Utne, Clinical Research: Case Studies of Successes and Failures, Publisher; Springer
2. Duolao Wang and Ameet Bakhai, Clinical Trials: A Practical Guide to Design, Analysis, and Reporting, Publisher; Remedica
3. Stephen P. Glasser, Essentials of Clinical Research, Publisher; Springer
4. Deborah Rosenbaum and Michelle Dresser, Clinical Research Coordinator Handbook, Publisher; Interpharm/CRC
5. Evan DeRenzo and Joel Moss, Writing Clinical Research Protocols: Ethical Considerations, Publisher; Elsevier
6. Guidelines: ICH, USFDA, Drugs and Cosmetics Act, EMA

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 306-19	ICT Skills Lab	-	-	4	30	20	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is designed to improve the student learning through the technology

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basics of ICT and the terminologies used in ICT
CO2	Appreciate the potential of technologies in modern society
CO3	Learn about and using different kinds of IT tools suitably and safely
CO4	Search information on the internet in digital encyclopedias, repositories, etc., or using search engines, in a systematic and coherent fashion
CO5	Understand basic functions of a search engine and implement search criteria definition strategies for filtering the results obtained

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	1	1	1	2	1	2
CO2	1	1	1	1	1	1	1	1	2
CO3	3	1	1	1	1	1	1	1	1
CO4	3	1	1	1	1	3	3	1	2
CO5	3	1	1	1	1	3	3	1	2

1. ICT: meaning, advantages, disadvantages and uses
2. General abbreviations and terminology of ICT
3. Basics of internet and emailing
4. Use of internet in research works
5. Literature survey of the previous works and searches for articles online and in the library
6. Cyber laws
7. Database, concepts, components and uses

8. Information retrieval system
9. IT based library and information system
10. New developments in Information communication technology

Suggested Readings/ Books (Latest Edition)

1. Arnaudet, ML and Barrett, Communication Research Techniques: Methods and Applications, Wadsworth California
2. Donal Carburg, Distinctive Qualities in Communication and Research, Taylor and Francis
3. Chrisanthi Avgerou, Robin Mansell, Danny Quah, and Roger Silverstone, The Oxford Handbook of Information and Communication Technologies, Oxford University Press

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 311-20	Clinical Trial Operations	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To sensitize students regarding significance of real time planning and coordination of clinical trials

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the criteria for selection of clinical trial site and clinical investigators
CO2	Understand roles and responsibilities of various stakeholders in clinical trial
CO3	Conduct activities at the site related to maintenance of clinical trial documents
CO4	Understand the roles and responsibilities of monitors and auditors
CO5	Conduct activities related to trial site closure and submission of site close out report

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	1	3	3	1	3	1	2
CO2	2	1	3	1	1	2	3	2	3
CO3	1	1	3	3	1	3	3	3	1
CO4	1	1	1	2	2	3	3	3	1
CO5	1	1	1	1	3	3	3	2	2

Module-I **12 Hrs**

Selection of clinical trial sites, site-initiation visits, clinical investigators and making budget and outsourcing clinical trial related work and selection of vendor

The roles and responsibilities of the following in CT: sponsor, institution, clinical trial coordinator, clinical investigator

Documents required at site, site initiation and conduct activities, protocol, CRF, ICD, investigator brochure, clinical trial agreement, ethics committee and regulatory approval, site-initiation visits

Recruitment, IP/IMP/pharmacy file receipt and storage, clinical trial site master file,

databases, SOPs
Roles and responsibilities of monitors and auditors/inspectors, monitoring visits, audits and inspections, independent data monitoring activities

Module-II **12 Hrs**

Contingency planning to prepare for unexpected situations
Site close-out activities, suspending and premature termination of a trial
Handling missing data, query and resolution, database lock
Site close-out report, clinical study report, submission to ethics committee and regulatory agency, publication of results

Suggested Reading (Latest Edition)

1. Principles and practice of Clinical Research by John. I Gallin.; Academic Press
2. Principles and practice of clinical trial medicine by Richard Cin and Bruce Y. Lee; Academic Press
3. Guidelines like GCP, USFDA, EMEA, Indian GCP etc.
4. SK Gupta, Drug Discovery and Clinical Research, Jaypee Brothers, Medical Publishers Pvt. Ltd.
5. JoAnn Pfeiffer, Cris Wells, A Practical Guide to Managing Clinical Trials, CRC Press.
6. Lionel D. Edwards, Anthony W. Fox, Peter D. Stonier, Principles and Practice of Pharmaceutical Medicine, Blackwell Publishing Ltd.
7. Graham D. Ogg, A Practical Guide to Quality Management in Clinical Trial Research, CRC Press.
8. Delva Shamley, Brenda Wright, A Comprehensive and Practical Guide to Clinical Trials, Academic Press.

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 312-19	Medical Coding	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: This course is designed to instruct the students about various medical dictionaries used worldwide for the representation of the data

Course Outcomes: At the end of the course, the student will be able to

CO1	Categorize the medical terms appropriately
CO2	Analyze medical clinical narratives and correctly assign medical codes
CO3	Assign and understand diagnostic and procedure codes using ICD coding systems
CO4	Develop an understanding of medical coding as a data collection tool
CO5	Demonstrate entry level skills in coding

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	1	1	3	1	3	3	1
CO2	3	1	1	1	3	1	3	3	1
CO3	3	1	1	1	3	1	1	1	1
CO4	3	1	1	1	1	3	1	3	1
CO5	3	1	1	1	1	1	1	3	1

Module-I **12 Hrs**

MedDRA- Medical dictionary for regulatory activities
WHO-DDE-World Health Organization Drug dictionary
WHO-ART-World Health Organization Adverse reaction terminology

Module-II **12 Hrs**

International Classification of Diseases

Suggested Reading

1. ICH: M1 guidelines
2. https://www.who.int/classifications/icd/en/
3. https://www.cdc.gov/nchs/icd/

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 313-19	Pharmacoeconomics & Health Technology Assessment	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: To make students understand the basics concept and significance of pharmacoeconomics in clinical research

Course Outcomes: At the end of the course, the student will be able to

CO1	Outline the steps for conducting a pharmacoeconomic analysis
CO2	Identify strengths and issues associated with current pharmacoeconomic methods
CO3	Critique current pharmacoeconomic literature
CO4	Describe the rationale of pharmacoeconomic analysis
CO5	Understand impact of pharmacoeconomics of pharmaceutical care services on the health and health care of a community

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1	2	2	2	1	1	1	1
CO2	3	1	3	1	1	1	1	1	1
CO3	3	1	1	3	3	1	3	1	1
CO4	3	1	2	3	3	1	3	1	1
CO5	1	1	1	3	3	1	2	1	1

Module-I **12 Hrs**

Introduction to pharmacoeconomics

Definitions, costs and consequences in pharmacoeconomic studies, perspectives, difference between pharmacoeconomics and outcomes research

Types of pharmacoeconomic analysis: cost-effective analysis, cost-minimization analysis, cost- benefit analysis, cost-utility analysis, cost-offset analysis

Health related quality of life, health utilities index

Module-II **12 Hrs**

Health Technology Assessment

International Network of Agencies for Health Technology Assessment (INHATA)
Health Technology Assessment (HTA) system: practice and process
Models of Health Technology Assessment agencies
Structure of the Health Technology Assessment report: principles, practice and process

Suggested Readings/Recommended Books (Latest Edition)

1. Thomas E. Getzen, Health Economics: Fundamentals and Flow of Funds, Wiley
2. Michael Drummond, Mark Sculpher, George Torrence, Bernie O'Brien and Greg, Methods for the Economic Evaluation of Health Care Programmes, Oxford University Press
3. Andrew Briggs, Karl Claxton, Mark Sculpher, Decision Modeling for Health Economic Evaluation, Oxford University Press
4. http://www.inahta.org/

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
UC-MSCR 314-20	Quality Management in Clinical Trials	2	-	-	15	35	1	2	2

Pre-requisite: None

Co- requisite: None

Course Objectives: The course is designed to sensitize students regarding significance of quality control, and quality management in clinical trials

Course Outcomes: At the end of the course, the student will be able to

CO1	Contribute effectively in conduct of clinical studies taking into consideration the aspects of quality control and management.
CO2	Understand importance of clinical quality assurance department in industry
CO3	Conduct activities at the site related to maintenance source documents
CO4	Understand the roles and responsibilities of monitors and auditors/ inspectors in monitoring visits/ audits and inspections
CO5	To manage the clinical study appropriately for audits and regulatory inspections

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	1	1	2	1	3	2
CO2	3	1	3	1	1	2	1	3	2
CO3	3	1	2	1	1	2	1	3	1
CO4	1	3	2	1	1	2	1	2	2
CO5	2	1	2	1	1	3	1	2	2

Module-I **12 Hrs**

Quality Control, Quality Assurance and Total Quality Management
Overview of QA and QC in clinical trials and their comparison
Total quality management
Good clinical practice guidelines for quality assurance
Corrective and Preventive Action (CAPA) program, Root Cause Analysis (RCA)

Module-II **12 Hrs**

Audits/Inspections
Audits, its process and important aspects, types of audits
Clinical Quality Assurance Audit
Regulatory inspections
Source document verification
Risk based quality management & monitoring

Suggested Readings/Recommended Books (Latest Edition)

1. Graham D, Ogg, A practical guide to quality management in clinical trial research, CRC Press.
2. VM Madzarevic, Clinical Trial Audit preparation: A guide for Good clinical practice inspections, Wiley.
3. Regulatory guidelines: ICH, USFDA, Indian GCP.
4. JoAnn Pfeiffer, Cris Wells, A Practical Guide to Managing Clinical Trials, CRC Press.
5. Lionel D. Edwards, Anthony W. Fox, Peter D. Stonier, Principles and Practice of Pharmaceutical Medicine, Blackwell Publishing Ltd.
6. Graham D. Ogg, A Practical Guide to Quality Management in Clinical Trial Research, CRC Press.
7. Delva Shamley, Brenda Wright, A Comprehensive and Practical Guide to Clinical Trials, Academic Press.

Course Code	Course Title	Teaching Load			Marks		Exam	Credits
		L	T	P	Int.	Ext.	Internal	
UC-MSCR 106-19 UC-MSCR 206-19 UC-MSCR 306-19	Journal Club	-	-	4	50	-	Continuous Mode	2

Pre-requisite: None

Co- requisite: Professional Communication (UC-MSCR 105-19), Professional Communication Lab (UC-MSCR 204-19), ICT Skills Lab (UC-MSCR 305-19)

Course Objectives: The course is designed to instil an analytical temperament in the students for critical review of the existing literature and better understanding of clinical research.

Course Outcomes: At the end of the course, the student will be able to

CO1	Critically review the literature
CO2	Develop an approach to analyse the various types of articles
CO3	Become familiar with sources of bias and types of study designs
CO4	Comprehend how results of study are clinically significant
CO5	Demonstrate skill in scientific communication both orally and in writing

Mapping of course outcomes with the programme outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1	3	3	2	2	3	2	1
CO2	2	1	3	3	3	3	3	2	1
CO3	2	1	1	2	2	3	3	2	1
CO4	2	1	2	2	3	3	3	2	1
CO5	1	1	1	1	1	1	1	1	3

Instructions

1. Students are to work with assigned mentor to chose and analyze an appropriate article followed by a power point presentation.
2. Power-point presentations should be organized as follows: 10 minutes background, 10 minutes article 15 minutes analysis 5 minutes discussion

3. Students are encouraged to critically appraise the literature, and develop their own independent criticisms
4. Minimum two presentations in a semester by each student

Choice Based Credit System

Scheme & Syllabus of

Bachelor of Science (Hons) in Food Technology

B.Sc. (Hons)Food Technology

Batch 2021 onwards

By

Board of Study Food Engineering

Department of Academics

IK Gujral Punjab Technical University

Vision:

To create competent professionals those, contribute towards the economic development of the nation by going in line with the policy of Government of India in the field of food processing food safety and security.

Mission:

• Development of human resources in the field of food science and technology to serve the cause of nation

• Providing a strong theoretical and practical background across the food science discipline with an emphasis on developing sustainable resources to cater food and nutrition related challenges

• Development of human resources in the area of clinical nutrition and research to contribute effectively in making India healthy

• Create favorable environment for innovation to translate theoretical knowledge into practical applications

• Inculcating professional ethical values, innovative research capabilities and leadership abilities

• Holistic development of the youth through the process of self evaluation and continuous improvement

Program Education Objectives:

1. To make the students competent in developing the foods of the future by utilizing technologies such as dehydration, freezing, irradiation, fermentations, applications of enzymes in food processing, food product development, nutraceuticals, nutritional and functional foods.
2. To keep students abreast with the rapid developments reported within technology and biological science that is creating completely new ways of developing various processed food.
3. To impart an understanding of modern food processing and profound knowledge of technology associated with the development of healthy and safe foods.
4. To motivate and enable students of BSc. Food Science & Technology to opt for higher levels of learning viz. post-graduate program, doctoral programs by research in this interdisciplinary field with the view of developing highly skilled professionals to work in Industry and academia.

Program Outcomes:

1. To impart knowledge of various areas related to Food Science and Technology
2. To enable the students to understand food composition and its physico- chemical, nutritional, microbiological and sensory aspects,
3. To familiarize the students about the processing and preservation techniques of pulses, oilseeds, spices, fruits and vegetables, meat, fish, poultry, milk & milk products,
4. To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.
5. To impart an understanding of modern food processing and profound knowledge of technology associated with the development of healthy and safe foods.

Mapping of Program Outcomes with Program Education Objectives:-

POE / PO	POE1	POE2	POE3	POE4
PO1	**1**	**1**	**1**	**3**
PO2	**1**	**1**	**1**	**2**
PO3	**1**	**1**	**1**	**2**
PO4	**1**	**2**	**1**	**1**
PO5	**1**	**1**	**1**	**1**

Bachelors of Science (Hons) in Food Technology: B.Sc. (Hons) Food Technology
It is a Under Graduate (UG) Programme of 4 years duration (8 semesters)

Eligibility for Admission: A Candidate who has passed Plus Two (Science) or Plus Two arts with food preservation /food science and technology vocational subject of the Punjab School Education Board / C.B.S.E. / I.C.S.E. with 40% marks or any other equivalent examination.

Courses & Examination Scheme:

Semester First

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSFT111-21	Introduction to Food Science	4	0	0	40	60	100	4
BSFT112-21	Technology of Food Preservation	4	0	0	40	60	100	4
BSFT113-21	Lab - Introduction to Food Science	0	0	4	30	20	50	2
BSFT114-21	Lab - Technology of Food Preservation	0	0	4	30	20	50	2
	GE -1*	4	0	0	40	60	100	4
	GE -1 Lab*	0	0	4	30	20	50	2
BTHU103-18	English	1	0	0	40	60	100	1
BTHU104-18	English (Lab)	0	0	2	30	20	50	1
HVPE101-18	Human Values, De-addiction and Traffic Rules	3	0	0	40	60	100	3
HVPE102-18	Human Values, De-addiction and Traffic Rules (Lab/ Seminar)	0	0	1	--	25*	25*	1
	Mentoring and Professional Development	0	0	1	25*	---	25*	1
	Total	**16**	**0**	**16**	**345**	**405**	**750**	**25**

* The student is required to register for Generic Elective Courses of his/her choice from any department other than the parent department. The credit of the subject should be as highlighted in a scheme where as the marks scheme for Generic Elective Courses can be depend on subject selected by the students from other department.

-The Human Values, De-addiction and Traffic Rules (Lab/ Seminar) and Mentoring and Professional Development course will have internal evaluation only.

Semester Second

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSFT121-18	Food and Nutrition	4	0	0	40	60	100	4
BSFT122-18	Post-harvest management of Fruits & Vegetables	4	0	0	40	60	100	4
BSFT123-18	Lab - Food and Nutrition	0	0	4	30	20	50	2
BSFT124-18	Lab-Post-harvest management of Fruits & Vegetables	0	0	4	30	20	50	2
-	*SEEC-1	0	0	2	30	20	50	2
-	**GE -2 Theory	4	0	0	40	60	100	4
-	**GE – 2 Lab	0	0	4	30	20	50	2
EVS102-18	Environmental Science	2	0	0	40	60	100	2
MPD 202-18	***Mentoring and Professional Development	0	0	1	25	--	25	1
	Total	**14**	**0**	**15**	**305**	**320**	**625**	**23**

* The student is required to register anyone from Skill Enhancement Elective Course.

** The student is required to register for Generic Elective Courses of his/her choice from any department other than the parent department. The credit of the subject should be as highlighted in a scheme whereas the marks scheme for Generic Elective Courses can depend on subject selected by the students from other department.

*** Mentoring and Professional Development course will have internal evaluation only.

Semester Third

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSFT211-21	Food Microbiology	4	0	0	40	60	100	4
BSFT212-21	Food Chemistry-I	4	0	0	40	60	100	4
BSFT213-21	Technology of Fruits, Vegetables and Plantation Crops	4	0	0	40	60	100	4
BSFT214-21	Lab - Food Microbiology	0	0	4	30	20	50	2
BSFT215-21	Lab - Food Chemistry-I	0	0	4	30	20	50	2
BSFT216-21	Lab- Technology of Fruits, Vegetables and Plantation Crops	0	0	4	30	20	50	2
	GE -3 Theory	4	0	0	40	60	100	4
	GE – 3 Lab	0	0	4	30	20	50	2
BMPD302-18	Mentoring and Professional Development	0	0	1	25*	--	25	1
	Total	**18**	**0**	**17**	**335**	**340**	**675**	**27**

Note: * Mentoring and Professional Development course will have internal evaluation only.

Semester Fourth

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSFT221-21	Technology of Cereals, Pulses and	4	0	0	40	60	100	4
BSFT222-21	Food Chemistry-II	4	0	0	40	60	100	4
BSFT223-21	Technology of Meat, Fish & Poultry	4	0	0	40	60	100	4
BSFT224-21	Lab - Technology of Cereals, Pulses and Oilseeds	0	0	4	30	20	50	2
BSFT225-21	Lab - Food Chemistry-II	0	0	4	30	20	50	2
BSFT226-21	Lab- Technology of Meat, Fish & Poultry	0	0	4	30	20	50	2
	SEEC-2	0	0	2	30	20	50	2
	GE -4 Theory	4	0	0	40	60	100	4
	GE – 4 lab	0	0	4	30	20	50	2
BMPD402-18	Mentoring and Professional Development	0	0	1	25*	--	25	1
	Total	**18**	**0**	**17**	**335**	**340**	**675**	**27**
Note: * Mentoring and Professional Development course will have internal evaluation only.								

Important Notes: -

1. The department will offer the Generic Elective Courses for the students of other department.
2. Theory courses will be of 04 hours and practical will be of 04 hours duration per week. For all lecture courses, one credit per lecture/week/semester will generally be adopted. One laboratory hour per week per semester will be assigned half credit.
3. No elective course will be run unless the number of students registered for the elective course is five or more.
4. The student is required to register for Generic Elective Courses of his/her choice from any department other than the parent department.

SEMESTER FIRST

BSFT111-21: INTRODUCTION TO FOOD SCIENCE

Total Marks: 100	L	T	P
	4	0	0

Course Objectives:

- To study the structure, composition, nutritional quality and post -harvest changes of various plant foods.
- To impart basic knowledge regarding processing aspects of different foods
- To study the structure and composition of various animal foods.

UNIT I

Introduction: - Introduction to food science, food technology and food engineering. Status of food industry in India and abroad.

Nutrients and functions of food *viz.* Carbohydrates, Protein, Lipids, Vitamins, Minerals. Changes in nutrients during processing and storage of food.

Water: Physical properties of water and Ice, chemical, nature, structure of the water molecule. Absorption phenomena, types of water solutions and collidative properties; Free and bound water; Water activity and Food spoilage; Freezing and Ice structure.

UNIT II

Food Dispersions- Introduction, structure and stability of different types of food dispersions

Composition and nutritive value of plant foods

Cereals and millets: General outline, Composition & Nutritive value, Structure of wheat and Rice, Changes during cooking and germination of cereals and millets grains.

Pulses: Composition, Nutritive value, Antinutritional factors Changes during cooking, Factors affecting and changes during processing of pulses-soaking, germination, decortications, cooking and fermentation.

UNIT III

Composition and nutritive value of plant foods

Nuts & Oilseeds: Composition, sources of proteins and oil, classification of lipids, types of fatty acids, Processing of oil seeds - Soya bean, coconut; Protein isolates; Texturized vegetable protein. Rancidity- Types- hydrolytic and oxidative rancidity and its prevention.

Fruits & Vegetables: Composition, Classification, Nutritive value, Vegetable Cookery, Changes during maturing, Ripening, storage and cooking of fruits and vegetables. Climacteric, Non climacteric fruits, Concept of enzymatic browning.

Spices & herbs: Definition, Classification, Chemical composition, use of spices & herbs. Overview of essential oils and oleoresins.

UNIT IV

Composition and Nutritive Value of Flesh Foods
Eggs: Structure, Composition, Nutritive value of egg, Grading Changes during cooking & storage.

Fish: Composition, Nutritive value of fish, effect of different processing.

Meat: Structure, composition, types and nutritive value of meat, effect of different processing

Composition and Nutritive Value of dairy products

Milk: Definition, composition, nutritive value of milk and milk products; An overview of types of market milk and milk products; changes during processing like pasteurization and homogenization and storage of milk and milk products

Health Foods

Health foods: Concept of Nutraceuticals, Functional foods, Prebiotics, Probiotics, organic foods, GM foods

Recommended Readings:

1. Deman JM, Principles of Food Chemistry, Van Nostrand Reinhold, NY
2. Meyer LH, Food Chemistry, CBS Publication, New Delhi
3. Manay NS and Shadaksharaswamy M, Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi
4. Potter NH, Food Science, CBS Publication, New Delhi
5. Ramaswamy H and Marcott M,Food Processing Principles and Applications CRC Press
6. De Sukumar, Outlines of Dairy Technology, Oxford Publishers
7. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi
8. Bawa A.S., O.P Chauhan et al. Food Science. New India Publishing agency
9. Roday S., Food Science, Oxford Publication
10. Srilakshmi B., Food Science, New Age Publishers

Course Outcomes:

CO1: To understand physico-chemical properties of macro and micro nutrients in food.

CO2: To understand classification and composition of food sources of plant and animal origin.

CO3: To access the nutritional values of different food sources.

CO4: To evaluate and understand the influence of processing on various food components.

CO5: To study the utilization of different food sources.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	1	1
PO3	3	3	3	1	3
PO4	3	3	3	3	3
PO5	2	3	1	3	1

BSFT112-21: TECHNOLOGY OF FOOD PRESERVATION

Total Marks: 100

L	T	P
4	0	0

Course Objective:

- To impart knowledge on the causes of food spoilage and principles of different techniques used in processing and preservation of foods.
- To identify and select preservation methods appropriate for specific foods and to learn the effects of preservation methods on the quality of food

UNIT I

Scope and importance of food preservation, Historical developments in food processing. Types of foods and causes of food spoilage. Definition of shelf life, perishable foods, semi perishable foods, shelf stable foods. Principles of Food Preservation

Food Microbiology: microorganisms associated with foods- bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms. Food infection, food intoxication.

UNIT II

Food Preservation by Low temperature

Freezing and Refrigeration: Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e.slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.

Food Preservation by high temperature

Thermal Processing- Introduction, classification of Thermal Processes, Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time, Lethality concept, characterization of heat penetration data, Thermal process Calculations; Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.

UNIT III

Food Preservation by Moisture control

Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve,; Effect of food properties on dehydration, change in food during drying ,drying methods and equipments air convection dryer, tray dryer, tunnel dryer ,continuous belt dryer , fluidized bed dryer, spray dryer, drum dryer, vacuum dryer ,freeze drying ,foam mat drying.

Evaporation – Definition, factors affecting evaporation, names of evaporators used in food industry.

UNIT IV

Ambient-Temperature Processing

Separation processes: Principles and methods of: washing, filtration, sedimentation, sieving and centrifugation

Food Preservation by Irradiation

Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of

action, uses of radiation processing in food industry, concept of cold sterilization.

Food Preservation by Preservatives: Uses and effects of class I and class II preservatives in foods.

Recommended Readings:

1. Sivasankar, B. *Food processing and preservation:* Hall of India Pvt., New Delhi.
2. Fellows, P. J.. *Food processing Technology: Principles and Practice:* Woodhead Publishing.
3. Brennan, J. G. *Food Processing Handbook:* Weinheim: Wiley-VCH.
4. Zeuthen, P. & Bogh- Sprensen, L. Food Preservation Techniques: CRC Press, Bocaraton.
5. Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi
6. Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi
7. Potter NH, Food Science, CBS Publication, New Delhi
8. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press
9. Rao PG, Fundamentals of Food Engineering, PHI Learning Pvt Ltd, New Delhi
10. Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers.
11. Vonloesecka, H. W. *Drying and Dehydration of Foods:* Allied, Bikaner.
12. B. Srilakshmi, Food science, New Age Publishers.
13. Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency.
14. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi.

Course Outcomes:

1. To impart knowledge on the causes of food spoilage.
2. To learn principles of different techniques used in processing and preservation of foods.
3. To identify and select preservation methods appropriate for specific foods.
4. To learn the effects of preservation methods on the quality of food.
5. To learn different permitted food additive used in food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	3	2	3	3
PO3	1	1	1	1	1
PO4	2	2	1	1	1
PO5	3	1	1	2	1

BSFT113-21: INTRODUCTION TO FOOD SCIENCE (LAB)

Total Marks: 50

L	T	P
0	0	4

Course Objectives: To impart basic knowledge regarding the quantitative and qualitative evaluation of different foods

Course Content

1. Orientation to working in a food analysis lab.
2. Identification of different non-perishable commodities-cereals, millets and their by-products.
3. Quality evaluation/inspection of different foods. i. Spices and Condiments ii. Pulses iii. Nuts and oilseeds iv. Tea and coffee
4. Study of different types of browning reactions: enzymatic and non enzymatic.
5. To Study the germination of cereals and pulses.
6. Study of fermentation and dextrinization.
7. To study gelatinization behavior of various starches
8. Identification of pigments in fruits and vegetables and influence of pH on them
9. To study the concept of gluten formation of flour.
10. Estimation of reducing sugar by Fehlings procedure
11. Estimation of salt content in brine
12. Preparation of brix solution and checking by hand refractometer
13. Application of collioidal chemistry to food preparation
14. Demonstration of the Soxhlet method for determination of fat content
15. Determination of acidity of water
16. Determination of alkalinity/ hardness of water
17. Demonstration of the Kjeldahl's method for estimation of protein content
18. Quality inspection of animal foods.

Course Outcomes:

CO1: To acquaint the students to the work in the food analysis laboratory.

CO2: Introduction to fundamentals of food processing and evaluation.

CO3: Evaluation of composition and functionality of food products.

CO4: Explaining different methods used for food analysis.

CO5: Evaluation of food products by qualitative and quantitative methods.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	3	1	1	1	1
PO3	3	1	1	1	1
PO4	1	1	1	1	1
PO5	3	1	1	2	1

BSFT114-21: TECHNOLOGY OF FOOD PRESERVATION (LAB)

Total Marks: 50

L	T	P
0	0	4

Course Objective:

- To understand the effect of various preservation techniques on the quality and safety of food products.
- To design and evaluate a processing procedure used to preserve a food product.

Course Contents

1. Sampling techniques and preparation of test samples.
2. Concept of shelf life of different foods
3. To study the concept of Asepsis and sterilization
4. Determination of pH of different foods using pH meter.
5. Study quality characteristics of foods preserved by drying/dehydration/ freezing.
6. To perform pasteurization of fluids using different methods.
7. To perform blanching of different plant foods.
8. Pickling and curing of foods,
9. Determination of sodium chloride in brine,
10. Determination of moisture content in fresh and dried food samples,
11. Effect of pH on microbial stability of food,
12. Dehydration of foods
13. Use of chemical preservatives in food
14. Preservation of food by canning (Fruit/Vegetable/meat)
15. Cut-out analysis of canned food
16. Comparison of conventional and microwave processing of food

Course Outcomes:

1. To understand the sampling techniques and preparation of test samples.
2. To understand the effect of various preservation techniques on the quality and safety of food products.
3. To design and evaluate a processing procedure used to preserve a food product.
4. To understand the physical and chemical evaluation of thermally processed food.
5. To understand and utilize different food preservation techniques.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	1	1
PO3	1	1	1	1	1
PO4	2	1	1	1	1
PO5	3	2	2	2	1

BTHU103-18: ENGLISH

Total Marks: 100	L	T	P
	1	0	0

Course Objectives:

The objective of this course is to introduce students to the theory, fundamentals and tools of communication.

UNIT- I

Introduction

- Theory of Communication
- Types and modes of Communication

UNIT- II

Language of Communication

- Verbal and Non-verbal
- (Spoken and Written)
- Personal, Social and Business
- Barriers and Strategies
- Intra-personal, Inter-personal and Group communication

UNIT- III

Reading and Understanding

- Close Reading
- Comprehension
- Summary Paraphrasing
- Analysis and Interpretation
- Translation(from Hindi/Punjabi to English and vice-versa)
- Literary/Knowledge Texts

UNIT- IV

Writing Skills

- Documenting
- Report Writing
- Making notes
- Letter writing

Recommended Readings:

1. *Fluency in English* - Part II, Oxford University Press, 2006.
2. *Business English*, Pearson, 2008.
3. *Language, Literature and Creativity*, Orient Blackswan, 2013.
4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas
5. *On Writing Well*. William Zinsser. Harper Resource Book. 2001
6. *Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

Course Outcomes:

- To help the students become the independent users of English language.
- To develop in them vital communication skills which are integral to their personal, social and professional interactions.

- The syllabus shall address the issues relating to the Language of communication.
- Students will become proficient in professional communication such as interviews, group discussions, office environments, important reading skills as well as writing skills such as report writing, note taking etc.

BTHU104-18: ENGLISH (LAB)

Total Marks: 100	L	T	P
	2	0	0

The objective of this course is to introduce students to the theory, fundamentals and tools of communication.

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self Introduction, Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations
- Monologue
- Effective Communication/ Mis- Communication
- Public Speaking

Recommended Readings:

1. *Fluency in English* - Part II, Oxford University Press, 2006.
2. *Business English*, Pearson, 2008.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
5. *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes:

- To help the students become the independent users of English language.
- To develop in them vital communication skills which are integral to personal, social and professional interactions.
- The syllabus shall address the issues relating to the Language of communication.
- Students will become proficient in professional communication such as interviews, group discussions and business office environments, important reading skills as well as writing skills such as report writing, note taking etc.

HVPE101-18: HUMAN VALUES, DE-ADDICTION AND TRAFFIC RULES

Total Marks: 100	L	T	P
	3	0	0

UNIT- I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT- II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*- Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT- III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding harmony in the Family- the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
   Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship

3. Understanding the meaning of *Vishwas*; Difference between intention and competence
4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha)*- from family to world family!- Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT- IV

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature

3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT- V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
   a) Ability to utilize the professional competence for augmenting universal human order,
   b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
   c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
   a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
   b) At the level of society: as mutually enriching institutions and organizations

Recommended Readings:

1. Ivan Illich, 1974, *Energy & Equity,* The Trinity Press, Worcester, and HarperCollins, USA
2. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
3. A Nagraj, 1998, *Jeevan Vidya ek Parichay,* Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, *How the Other Half Dies,* Penguin Press. Reprinted 1986, 1991
5. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Purblishers.
6. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.
7. Subhas Palekar, 2000, *How to practice Natural Farming,* Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *Limits to Growth – Club of Rome's report*, Universe Books.
9. E G Seebauer & Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers ,* Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, *Engineering Ethics (including Human Values)*, Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, *Foundations of Ethics and Management,* Excel Books.
12. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
13. R R Gaur, R Sangal, G P Bagaria, 2009, *A Foundation Course in Value Education.*

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, *http://uhv.ac.in*
2. Story of Stuff, *http://www.storyofstuff.com*
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology – the Untold Story*

HVPE102-18: HUMAN VALUES, DE-ADDICTION AND TRAFFIC RULES (LAB/ SEMINAR)

Total Marks: 25	L	T	P
	0	0	1

One each seminar will be orgnizied on Drug De-addiction and Traffic Rules. Eminent scholar and experts of the subject will be called for the Seminar atleast once during the semester. It will be binding for all the students to attend the seminar.

MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	0	0	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SEMESTER SECOND

BSFT121-18: FOOD AND NUTRITION

Total Marks: 100

L	T	P
4	0	0

Course Objective

- To develop scientific awareness about linkage between food, nutrition and health
- To understand importance of balanced diet and source of various nutrient like carbohydrates, protein , vitamin etc.
- To develop ability for planning the meals and methodology of healthy cooking
- To understand legality of labeling and Guidelines of codex and FSSAI

UNIT I

INTRODUCTION TO FOOD AND NUTRITION: Basic terms used in study of food and nutrition, BMI and Nutritional Status, Understanding relationship between food, nutrition and health.

BALANCED DIET: Functions of food-physiological, psychological and social, Concept of Balanced Diet, Food Groups, Food Pyramid.

UNIT II

NUTRIENTS: Classification, digestion, functions, dietary sources, RDA, clinical manifestations of deficiency and excess and factors affecting absorption of the following in brief: Energy, Carbohydrates, lipids and proteins

UNIT III

NUTRIENTS: Classification, digestion, functions, dietary sources, RDA, clinical manifestations of deficiency and excess and factors affecting absorption of the following in brief: Fat soluble vitamins-A, D, E and K; Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C; Minerals – calcium, iron, iodine, fluorine, copper and zinc

UNIT IV

CONCEPTS OF MEAL PLANNING: Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people.

METHODS OF COOKING: Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various methods of cooking on foods.

NUTRITIONAL LABELING: Importance, global trends, codex guidelines, nutritional labelling in India, FSSAI guidelines.

Recommended Readings:

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi,(2005), Dietetics, Revised 5th edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby 1996). Perspectives in Nutrition, Third Edition.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2_1985) (Rev.1_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
6. Food Safety and Standards Authority of India portal, Government of India
7. Gopalan, C., (1990). NIN, ICMR. Nutritive Value of Indian Foods.
8. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.
9. Introduction to Human Nutrition ed.Gibney et al, Blackwell Publishers, 2005
10. Khanna K, Gupta S, Seth R, Mahna R, Rekhi T (2004). The Art and Science of Cooking: A Practical Manual, Revised Edition. Elite Publishing House Pvt Ltd.

11. NIN, ICMR (1990). Nutritive Value of Indian Foods.
12. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.
13. ICMR (2010). Nutrient Requirements and Recommended Dietary Allowances for Indians.

Course outcomes

- To be practice oriented nutritionist
- To manage advisory role as meal planner
- To have scientific cooking methodologies as per nutritionist guidelines
- To understand labeling content for Food products

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	1
PO2	1	1	1	1
PO3	2	1	1	1
PO4	2	2	2	1
PO5	1	1	1	1

BSFT122-18: POST-HARVEST MANAGEMENT OF FRUITS & VEGETABLES

Total Marks: 100	L	T	P
	4	0	0

Course Objective

- Acquire knowledge on various management technologies on pre-harvest of fruits and vegetables.
- Acquire knowledge on various management technologies on post-harvest of fruits and vegetables.
- To study the different ripening stages of fruits and vegetables
- To understand the techniques of processing & preservation of fruits and vegetables.

UNIT I

Present status of post harvest technology in India.

Importance and role of post harvest technology.

Post harvest losses of fruits and vegetables and factors affecting the post harvest losses. Post harvest changes in fruits and vegetables Harvesting methods – manual and mechanical.

UNIT II

Maturity indices of fruits and vegetables-Importance of maturity indices, determination of harvest maturity Climacteric and Non climacteric fruits, Fruit ripening and changes, Ethylene biosynthesis.

UNIT III

Cleaning, Sorting & Grading of fruits and vegetables

Post harvest physical and chemical treatments to enhance the shelf life of fruit and vegetables.

UNIT IV

Transportation methods of fruits and vegetables Storage of fruits and vegetables Post harvest diseases of fruits and vegetables, Post harvest loss assessment and loss reduction.

Recommended Readings:

1. Preservation of fruits and vegetables by Girdhari Lal, Sidappa G S and Tandon G L, 1960, ICAR, New Delhi.
2. Food facts & principles by Shanuntala Manay N & Shadoksharaswamy N, 1996, New Age World Publisher, CA.
3. Food Science by Potter, N.N., CBS Publisher, New Delhi.

Course Outcomes:

- Understanding on the post-harvest losses and role of post-harvest technology.
- Knowledge on fruit and vegetable physiology, composition and various nutritional changes in fruits and vegetables.
- Understanding the maturity indices and quality criteria of fruits and their intervention in processing.
- Gaining knowledge on post-harvest techniques, packaging and storage interventions for shelf-life extension of fresh produce.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	1
PO2	2	2	2	2
PO3	3	2	2	2
PO4	1	1	1	1
PO5	2	2	2	2

BSFT123-18: FOOD AND NUTRITION (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objectives

- Practical exposure of students in the area of food, their sources and nutritional value.
- To acquaint the students regarding concept of food assimilation, nutrition through lifecycle, and malnutrition.
- To understand the concept of nutritious snacks, convenience foods and nutrition labelling.
- To acquire knowledge about meal planning for different age group.

Course Content

1. Identification of food sources for various nutrients using food composition tables.
2. Record diet of self-using 24 hour dietary recall and its nutritional analysis.
3. Introduction to meal planning, concept of food exchange system.
4. Planning of meals for adults of different activity levels for various income groups.
5. Planning of nutritious snacks for different age and income groups.
6. Preparation of nutritious snacks using various methods of cooking.
7. Nutritional labeling of food products.
8. Estimation of BMI and other nutritional status parameters.

Course Outcome:

- Determination of various food nutrients, sources, and associated deficiencies,
- Understanding about concept of nutritious snack, their preparation for different income groups.
- Understanding the concept of nutrition labelling.
- Understanding about food assimilation and malnutrition.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	1
PO2	1	1	1	1
PO3	2	1	1	1
PO4	2	2	2	1
PO5	1	1	1	1

BSFT124-18: POST-HARVEST MANAGEMENT OF FRUITS & VEGETABLES (LAB)

Total Marks: 100	L	T	P
	4	0	0

Course objectives

- Practical exposure of students in the area of post-harvest technology of fruits and vegetables.
- To acquaint the students regarding effects of pre-processing treatments on shelf-life of fruit.
- To understand the techniques of processing & preservation of fruits and vegetables.
- To study the different ripening stages of fruits and vegetables

Course Content

1. Analyze the maturity stages of fruits and vegetables.
2. To study the effect of pre-packing of fruits and vegetables.
3. To study the effect of pre-cooling of fruits and vegetables.
4. To study the ripening of fruits and vegetables.
5. To study the shelf life of fruits and vegetables at low- temperature.
6. To study the different types of spoilage in fruits and vegetables.
7. To determine the optimum temperature for storage of different fruits and vegetables.
8. To study the effect of wax coating on shelf life of fruits and vegetables.
9. Visit to a cold store and controlled atmosphere storage.

Course Outcomes: On completion of the course the students are expected to:

- Determine and understand the maturity indices of fruits and vegetables.
- To understand the effect of pre-cooling and pre-packaging of fruits and vegetables.
- To acquire knowledge about the types of spoilage and shelf life of fruits and vegetables.
- To understand the effects of optimum temperature, wax coating and control atmosphere storage.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	1
PO2	1	1	1	1
PO3	2	1	1	1
PO4	3	2	2	1
PO5	1	1	1	1

EVS102-18: ENVIRONMENT STUDIES

Total Marks: 100

L	T	P
2	0	0

UNIT- I

Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

UNIT- II

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- III

Natural Resources : Renewable and Non-•-renewable Resources

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-•-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-•-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

UNIT- IV

Biodiversity and Conservation

- 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 Informational value.

UNIT- V

Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

UNIT- VI

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

- Environment Laws: Environment Protection Act; Air (Prevention & 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).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

UNIT- VII

Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones 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).

UNIT- VIII : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a 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.

***Recommended readings*:**

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36-•-37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29-•-64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University Press.

MPD202-18: MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25

L	T	P
0	0	1

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SKILL ENHANCEMENT ELECTIVE COURSES

BSCSEC-101-21: ENTREPRENEURSHIP DEVELOPMENT

Total Marks: 50(30 Internal + 20 external)	L	T	P
	0	0	2

Course Objectives

- Evaluation and development and of entrepreneurial skills
- Business opportunity Identification and learning of assessment techniques
- Preparation of food business plan
- SWOT Analysis for food business

UNIT I

ENTREPRENEURIAL DEVELOPMENT: Case studies of successful entrepreneurs; Exercises on ways of sensing opportunities – sources of idea, creating efforts, SWOT Analysis; Entrepreneurial skill assessment test; Techniques of development of entrepreneurial skills, positive self image and locus of control

UNIT II

FOOD BUSINESS MANAGEMENT: Case studies of Food Processing Business and its aspects; Business opportunity Identification and Assessment techniques; Business Idea Generation and evaluation exercise; Market Assessment study Analysis of competitive situation; SWOT Analysis for business and for competitors; Preparation of business plan; Preparation of project report; Methods of Arrangement of inputs – finance and material.

Recommended Readings

1. Vasant Desai (2012) Fundamentals of Entrepreneurship and Small Business Management, Himalya Publishing House Pvt. Ltd., Mumbai
2. Vasant Desai (2011) The Dynamics of Entrepreneurial Development and Management, Himalya Publishing House Pvt. Ltd., Mumbai
3. D. David and S Erickson (1987) Principles of Agri Business Management, Mc Graw Hill Book Co., New Delhi.
4. Acharya S S and Agarwal N L (1987) Agricultural Marketing in India, Oxford & ISH Publishing Co., New Delhi.
5. David H. Holt (2002) Entrepreneurship – Anew Venture Creation, Prentice Hall of India, New Delhi.
6. Phill Kottler (1994) Marketing Management, Prentice Hall of India Private Limited, New Delhi.
7. Chandra, Prasanna (1996) Projects, Planning, Analysis, Selection, Implementation and Review, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Outcomes:

- To help the students to become the food entrepreneur.
- To develop the ability to entrepreneurial skills.
- To develop the skills related to Business feasibility analysis such as technical Feasibility, economic Feasibility, organizational feasibility and legal Feasibility.
- To able to develop Food Processing Business plan.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	2	1	1
PO2	3	3	3	3
PO3	3	3	1	2
PO4	3	3	2	2
PO5	3	2	2	2

SEMESTER

THIRD

BSFT211-21: FOOD MICROBIOLOGY

Total Marks: 100

L	T	P
4	0	0

Course objective: To understand the role and significance of microbes of different categories, microbial inactivation and environmental factors that affect them in foods.

UNIT I

Introduction to Food Microbiology: History and Development of Food Microbiology; Definition and Scope of food microbiology, Inter-relationship of microbiology with other sciences

Characteristics of Microorganisms in Food: Types of microorganisms associated with food, their morphology and structure; Significance of spores in food microbiology

UNIT II

Microbial Growth in Food: Bacterial growth curve and microbial growth in food; Factors affecting the growth of micro-organisms in food: Intrinsic and extrinsic factors; Biochemical changes caused by micro-organisms

Microbial Food Spoilage: Sources of Microorganisms in foods, Some important food spoilage microorganisms; Spoilage of specific food groups- Milk and dairy products, Meat, poultry and seafoods, Cereal and cereal products, Fruits and vegetables and Canned products.

UNIT III

Food Fermentations: Fermentation–definition and types; Microorganisms used in food fermentations; Dairy Fermentations-starter cultures and their types , concept of probiotics, Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso, soya sauce, beer, wine and traditional Indian foods

Foodborne Diseases: Types – foodborne infections, foodborne intoxications and toxic infections; common and Recent Examples

Cultivation of Micro-organisms: Pure culture technique; Methods of isolation and cultivation; Enumeration of Microorganisms- qualitative and quantitative

UNIT IV

Control of Microorganisms in Foods: Principles and methods of preservation; Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment (esp. thermobacteriology), Irradiation, Biopreservatives esp. Bacteriocins, Introduction to Hurdle concept and Non Thermal methods

Trends in Food Microbiology: Rapid Methods of Detection, Recent Advances

Recommended readings:

1. Frazier, W. C. and Weshoff, D. C. (2015). *Food Microbiology*: Tata McGraw Hill Publication, New Delhi.

2. Adam, M. R. & Moss, M. O. (2008). *Food Microbiology:* Royal Society of Chemistry, Cambridge.
3. James, M. J. (2005). *Modern Food Microbiology* (5th ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5th ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applicants*. Prentice Hall, New Jersey.
6. Garbutt, John. Essentials of Food Microbiology, Arnold, London, 1997
7. Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993

Course Outcomes:

1. Understand the principles involving food spoilage and preservation involving microorganisms and explain why microbiological quality control programmes are necessary in food production.
2. Ability to identify the characteristics of important pathogens and spoilage microorganisms in foods.
3. Understand the role and significance of intrinsic and extrinsic factors on growth of microorganisms in foods and differentiate which organisms would be likely to grow in a specific food product.
4. Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated killed or made harmless in foods and identify ways to control microorganisms in foods.
5. Describe the beneficial role of microorganisms in fermented foods and in food processing.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	2	2	1
PO2	1	1	1	1	1
PO3	1	2	2	2	1
PO4	1	1	2	1	2
PO5	1	2	1	2	2

BSFT212-21: FOOD CHEMISTRY – I

Total Marks: 100	L	T	P
	4	0	0

Course objective: To acquaint the students about chemistry, properties and effects of processing on food components.

UNIT I

Introduction to Food Chemistry: Definition, Composition of food

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

Lipids: Classification of lipids, Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. Chemical properties-reichert meissel value, polenske value, iodine value, peroxide value, saponification value. 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

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 eg. organoleptic, solubility, viscosity, binding gelation / texturization, emulsification , foaming. Effect of different processing on proteins.

UNIT III

Carbohydrates: Classification (mono, oligo and poly saccharides); Structure of important polysaccharides(starch, glycogen, cellulose, pectin, hemicellulose, gums); Chemical reactions of carbohydrates –oxidation, reduction , with acid & alkaki; Modified celluloses and starches. Effect of different processing on carbohydrates.

UNIT IV

Vitamins: Structure, Importance and Stability; Water soluble vitamins; Fat soluble vitamins, Effect of different processing on vitamins.

Recommended readings:

1. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
2. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
3. Wong, Dominic WS, Food Enzymes, Chapman and Hall, New York, 1995
4. Potter,N.N.and Hotchkiss,J.H, Food Science, 5th Ed., Chapman & Hall,1995
5. DeMan, J.M., Principles of Food Chemistry, AVI, NewYork, 1980

Course Outcomes:

1. Students shall be aware of the underlying chemistry, properties and effects of processing on food components.
2. Understanding of food components reactions and their impact on sensory, nutritional, and functional properties of foods.
3. Ability to identify the structure of food constituents and relate the structure to the constituents function and importance in foods with respect to food quality, nutrition, safety, processing, etc.

4. Ability to explain influence of factors such as temperature, pH, ionic characteristic and strength, bonding, etc. on chemical changes in food systems and judge how to adjust these conditions to improve or minimize chemical and biochemical deterioration of food systems.

5. Ability to integrate chemistry and biochemistry principles into real-world food science and nutritional problems.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	2	1	3	1
PO2	3	2	1	3	1
PO3	3	3	1	2	1
PO4	3	2	2	3	1
PO5	1	2	2	2	1

BSFT213-21: TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS

Total Marks: 100

L	T	P
4	0	0

Course objective: To develop knowledge regarding biochemistry and physiology of fruits and vegetables and their role in pre- and post-harvest changes in product quality.

UNIT 1

INTRODUCTION: Importance of fruits and vegetable, history and need of preservation, reasons of spoilage, method of preservation (short & long term). Classification and composition of fruits and vegetables and their nutritional significance. Physical and chemical indices of fruit maturity, crop maturity and ripening

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

FRUITS BEVERAGES: Introduction, 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.

JAMS, JELLIES AND MARMALADES: Introduction**,** Jam: Constituents, selection of fruits, processing & technology**,** Jelly: Essential constituents(Role of pectin, ratio), Theory of jelly formation, Processing & technology, defects in jelly**,** Marmalade : Types, processing & technology, defect

UNIT III

PICKLES, CHUTNEYS AND SAUCES: Processing , Types, Causes of spoilage in pickling**.**

TOMATO PRODUCTS: Selection of tomatoes, pulping& processing of tomato juice, tomato puree, paste, ketchup, sauce and soup.

DEHYDRATION OF FOODS AND VEGETABLES: Sun drying & mechanical dehydration, process variation for fruits and vegetables, packing and storage**.**

UNIT IV

SPICES: Processing and properties of major and minor spices, essential oils & oleoresins, adulteration**.**

TEA, COFFEE AND COCOA: Processing, Variety and Products.

Recommended Readings:

1. Jongen, W. (2002). *Fruit and vegetable processing: Improving Quality:* Woodhead Publishing, Boca raton.
2. Thompson, A. K. (1996). *Post-harvest Technology of Fruit and Vegetables:* Blackwell, Australia.
3. Thompson, A. K. (2003). *Fruits and Vegetables- Harvesting, Handling and Storage:* Blackwell, Oxford.
4. Verma, L. R. & Joshi, V. K. (2000). *Post-harvest Technology of Fruits and Vegetables:* Indus, New Delhi.
5. Srivastava, R. P. & Kumar, S. (2001). *Fruit and Vegetable Preservation– Principles and Practices (3 ed.):* International Book distributing Co., Lucknow (India).
6. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
7. W B Crusess.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
8. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers
9. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, Second edition.
10. Srivastava, R.P. and Kumar, S. 2006 . Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.

Course Outcomes:

1. The students shall be able to understand Biological, Chemical & Physical Properties of Fruits & Vegetables.
2. The students shall be able to understand Technologies involved in Processing, Preservation & Value- Addition of Fruits & Vegetables.
3. Students shall be able to understand Industrial Processes for Commercial Production of Jams, Jellies, Marmalade, Fruit Juices, Concentutes, Fruit Juice Powder, Dehydrated Fruits, and Canning of Fruits & Vegetables.
4. Students shall be able to understand Basics of New Food Products Development & Ideas Generation for Product Development.
5. Students shall be able to understand Basics of By Product Utilization & Waste Utilization related to Fruits & Vegetables.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	1	1
PO3	2	1	2	3	1
PO4	3	2	3	1	2
PO5	3	1	1	1	1

BSFT214-21: FOOD MICROBIOLOGY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To understand the microbial techniques and to develop skills related to microbial quality evaluation of foods using various techniques.

Course Content

1. Introduction to the Basic Microbiology Laboratory Practices and Equipment's
2. Functioning and use of compound microscope
3. Cleaning and sterilization of glassware
4. Preparation and sterilization of nutrient broth
5. Cultivation and sub-culturing of microbes
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's staining
10. Standard Plate Count Method
11. Microbiology of raw and processed foods:
    a. Microbiological analysis of food products-
        i. Bacterial count,
        ii. Yeast and mold count,
        iii. Coliform count,
        iv. Standard plate count of milk and direct microscopic count of milk,
        v. Reductase Test (MBRT).
    b. Microbiological testing of water-
        i. Quantitative test,
        ii. Bacteriological quality testing (MPN).

Course Outcomes:

1. Acquire the practical skills for the sampling of foods to carry out microbial analysis.
2. Ability to carry out various sterilization techniques and to identify the most suitable technique for specific food.
3. Ability to isolate and identify common food borne microbial pathogens.
4. Understand microbiological analysis methods for food products and ability to analyze different foods for presence of hazardous microorganisms using food microbiology technology.
5. Ability to interpret microbiological analysis of food products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	2	2	1	1
PO2	1	2	1	1	1
PO3	3	1	2	1	2
PO4	3	2	1	1	1
PO5	3	1	1	1	1

BSFT215-21: FOOD CHEMISTRY – I (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective:

To enable students to learn basic principles and procedure of starch, sugar and fat analysis.

Course Content

1. Preparation of primary and secondary solutions
2. Estimation of moisture content
3. Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR.
4. Determination of refractive index and specific gravity of fats and oils.
5. Determination of smoke point and percent fat absorption for different fat and oils.
6. Determination of percent free fatty acids
7. Estimation of saponification value
8. Estimation of reducing and non-reducing sugars using potassium ferricyanide method.
9. Estimation of starch content.
10. Estimation of salt content in brine
11. Estimation of salt content in butter
12. Estimation of protein in any food product
13. Estimate the ascorbic acid in any juice
14. Estimation of iodine value
15. Estimation of peroxide value

Course Outcomes: 1. Acquire the practical skills for the chemistry, properties and effects of additives on GTR.

2. Ability to carry out refractive index, specific gravity, smoke point, fat absorption for different fats and oils.

3. Ability to isolate and identify free fatty acids, saponification value, reducing and non-reducing sugars.

4. ability to estimate the salt content in different food

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	2	2	2	2
PO2	1	1	1	1
PO3	2	3	3	3
PO4	3	3	3	3
PO5	2	2	2	2

BSFT216-21: TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS

Total Marks: 50

L	T	P
0	0	4

Course objective: To enable students to learn the evaluation of the quality of fruit and vegetables.

Course Content

1. Estimation of total soluble solids (TSS).
2. Estimation of pH and acidity of product.
3. Estimation of brix: acidity ratio.
4. Estimation of ascorbic acid and effect of heat treatment on it
5. To study the steps of can making process.
6. Preparation and evaluation of pectin products.
7. Adulteration of spices.
8. Dehydration of fruits and vegetables.
9. Rehydration of fruits and vegetables.
10. Preparation and evaluation of sauce
11. Preparation and evaluation of Ketchup
12. Preparation of fruit juice products, Squash
13. Preparation and evaluation of pickle
14. Preparation and evaluation of Jam

Course Outcomes:

1. Ability to assess the quality of fruit and vegetables.
2. Ability to establish the quality specifications for the processing of fruit and vegetables.
3. Ability to develop various fruit and vegetable products with quality assurance and safety.
4. Understand principles and methods of preservation of fruits and vegetables.
5. To develop proficiency skill in preserving fruits and vegetables into various products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	2	2
PO3	1	1	1	1	1
PO4	1	1	1	1	1
PO5	2	1	1	1	1

BMPD302-18 MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	1	0	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

5. Sports/NSS/NCC
6. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SEMESTER

FOURTH

BSFT221-21: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Total Marks: 100	L	T	P
	4	0	0

Course Objective: To create knowledge about the processing and quality evaluation of cereal grains.

UNIT I

TECHNOLOGY OF CEREALS: Present status and future prospects of major cereals and millets in India and world, Morphology, composition, nutritive value and properties of various food grains including cereals, pseudocereals, millets and other coarse grains.

Wheat- varieties and quality characteristics, milling process- conditioning and tempering, equipments in wheat milling- disc mill, hammer mill, roller mill, functionality in bakery products, Extruded wheat products, pasta products

Paddy- threshing, drying and storage, parboiling processes- drying, milling operations, precleaners, shellers and hullers, separators, polishers, rice mill yields and losses at different stages of milling, processed rice products.

UNIT II

Corn – Milling (wet & dry) , cornflakes, corn flour

Barley- Milling (pearl barley, barley flakes & flour)

Oats – Milling (oatmeal, oatflour & oatflakes)

Sorghum and millets – Traditional & commercial milling (dry &wet) Rye and triticale—milling (flour),uses

UNIT III

TECHNOLOGY OF OILSEEDS:

Introduction, Extraction of oil and refining, Sources of protein (defatted flour, protein concentrates and isolates), properties and uses, protein texturization, fibre spinning

UNIT IV

TECHNOLOGY OF PULSES

Pulses in India and world, Morphology, composition, nutritive value, Milling of pulses, Dry milling, Wet milling, Improved milling method

Recommended Readings:

1. Kent, N.L. 2003. Technology of Cereal, 5th Ed. Pergamon Press.
2. Chakraverty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
3. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
4. Manay, S. and Sharaswamy, M. 1987. Food Facts and Priniciples.Wiley Eastern Limited.

Course Outcomes:

1. Student will acquire the understanding of the technology for Wheat Milling & Wheat based Food Products.
2. Student will acquire the understanding of the technology for Rice Milling & Rice based other Food Products.
3. Student will acquire the understanding of working of equipments related to Wheat & Rice Milling along with equipments related to Wheat based & Rice based Food Products.
4. Student will be able to understand technology for Milling of Corn & Corn based other Food Products along with equipments.
5. Student will be able to understand technology for Oil Extraction & Oil Seed Processing along with equipments.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	2	1	1
PO3	1	1	1	1	1
PO4	2	2	2	2	2
PO5	1	2	2	2	2

BSFT222-21: FOOD CHEMISTRY – II

Total Marks: 100	L	T	P
	4	0	0

Course Objective: To acquaint the students about chemical processes within food products particularly minerals, pigments, enzymes and flavors.

UNIT 1

Minerals: Major and minor minerals; Metal uptake in canned foods; Toxic metals

Natural Food Pigments: Introduction and classification; Food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

UNIT II

Enzymes: Introduction, classification, General characteristics, Enzymes in food processing, Industrial Uses of Enzymes, Immobilized enzymes

Browning Reactions in Food: Enzymatic browning, Non – Enzymatic browning, Maillard reaction, Caramelization reaction, Ascorbic acid oxidation

UNIT III

Flavour: Definition and basic tastes; Chemical structure and taste; Description of food flavours; Flavour enhancers

UNIT IV

Physico-chemical and nutritional changes occurring during food processing treatments: Drying and dehydration, Irradiation, Freezing, Canning

Recommended Readings:

1. deMan, John M., Principles of Food Chemistry ,3rd Ed., Springer 1999
2. Desrosier, Norman W. and Desrosier.,James N.,The technology of food preservation , 4th Ed.,Westport, Conn. : AVI Pub. Co., 1977.
3. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York,1996
4. Fuller, Gordon W, New Product Development From Concept to Marketplace, CRC Press,2004.
5. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002

Course outcome:

1. Students should be capable for optimizing food processing through understanding and chemical processes involved in enzymes, minerals and pigments.
2. Students have understanding and application of maillard reaction, caramelization and flavor enhancing mechanism.
3. Students will be introduced to food processing treatments like drying, irradiation, freezing and canning in terms of chemistry involved in the techniques.
4. Students will develop integrating chemical processes with technology to achieve skills in food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	2
PO2	2	1	1	1
PO3	1	2	1	2
PO4	1	1	1	1
PO5	2	1	1	1

BSFT223-21: TECHNOLOGY OF MEAT, FISH AND POULTRY

Total Marks: 100

L	T	P
4	0	0

Objective: This course shall educate students about the significance and necessity of organized animal products sector, humane slaughtering of animals and poultry and value addition of meat, poultry, egg and fish.

UNIT I

Introduction: Livestock and poultry population in India, Development of meat and poultry industry in India and its need in nation's economy, Glossary of live market terms for animals and birds. Structure, composition and nutritive value of meat. Conversion of muscle into meat. Factors affecting meat quality. Post-mortem changes in meat, thaw rigor, cold shortening, pre-rigor processing.

Meat quality: Effects of feed, breed and environment on production of meat animals and their quality Meat Quality-color, flavor, texture, Water-Holding Capacity(WHC),Emulsification capacity of meat

UNIT II

Slaughter process: Slaughter, inspection and grading, Antemortem examination of meat animals, slaughter of buffalo, sheep/ goat, poultry,pig A Generic HACCP model, dressing of carcasses, post-mortem examination of meat

Preservation of meat: Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing. Sausages-processing, types and defects

UNIT III

Introduction: Status of fishery industry in India.

Chilling and Freezing of fish: Relationship between chilling and storage life, MAP, general aspects of freezing, freezing systems (air blast freezing, plate or contact freezing spray or immersion freezing, freezing on board, onshore processing, changes in quality in chilled and frozen storage, thawing.

Fish Curing and Smoking: 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.

Canning of fish: 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.

Fermented fish: Flowchart of Indigenous products- Fish sauce and Paste

Concept of other Sea foods: Crabs, lobsters, prawns, shrimps, shell- fish.

UNIT IV

Egg Industry and Egg Production Practices The egg industry, its techniques of working, General management, structure, composition and nutritive value of egg and its products.

Preservation of eggs: Refrigeration and freezing, thermal processing, dehydration, coating.

Quality identification of shell eggs: Factors affecting egg quality and measures of egg quality.

By-products of meat, fish and egg industry: Utilization of meat, fish and egg industry by-products: importance, food and non-food applications Manufacture of Natural casings, Surimi-Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparision of surimi and fish mince products. Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis (FPH)

Recommended Readings:

1. Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
2. Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
3. Pearson & Gillet Processed Meats,3 Ed, CBS Publication, New Delhi, 1997
4. Shai Barbut,Poultry Products Processing,CRC Press 2005
5. Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4th Ed. CBS Publication New Delhi, 2002
6. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
7. Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt.Limited 2005
8. Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London,1994

Course Outcome:

1. Student shall know about the significance & necessity of organized animal product sector.
2. Students shall acquire the ability of value- addition to Meat, Poultry, Egg & Fish.
3. Student shall be well versed with processing, preservation & quality control of Meat, Egg & Fish in Food Industry.
4. Student shall be well versed with manufacturing practices of egg based, fish based and meat based by products & their processing techniques.
5. Student will be having broad knowledge of status & scope of Meat, Egg, & Poultry industry world wide.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	1	1	1
PO2	1	1	1	1	2
PO3	2	1	1	1	1
PO4	2	2	1	1	2
PO5	2	1	1	1	1

BSFT224-21: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS (LAB)

Total Marks: 50

L	T	P
0	0	4

Objective: To familiarize the students with quality tests of wheat flour and yeast with reference to bread processing and to equip them with the necessary skills for bread, biscuits and cookies processing.

Course Content

1. Estimation of different physicochemical characteristics of cereals grains.
2. Milling of different cereals grains.
3. Milling quality evaluation of wheat grains.
4. Functional quality test of wheat flour-
   a. Wet & dry gluten content

b. SDS sedimentation maltose value

c. Falling number values of wheat flour

d. Dough raising capacity of yeast.

4. Estimation of Pelenske Value of flour.
5. Estimation of Potassium Bromate in flour.
6. Fermenting power of yeast.
7. Cooking characteristics of rice.
8. Test baking of bread, biscuits and cake.
9. Effect of parboiling treatment on the milling quality of rice.
10. Effect of degree of polishing on the milling quality of rice.

Course Outcomes:

1. Student shall be well versed with Processing Techniques of Cereals.
2. Student shall be well versed with quality parameters of cereals.
3. Student will be able to understand practical implication of Milling of Wheat & Rice.
4. Student will be able to get acquaintance with machinery being utilized in Milling of Wheat & Rice.
5. Student will be able to understand Lab SOPs for above.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	2	2	1
PO2	2	1	2	2	1
PO3	1	1	2	2	1
PO4	1	1	1	1	1
PO5	2	1	2	3	1

BSFT225-21: FOOD CHEMISTRY – II (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective:

Students shall understand the quality analysis methods and new product development concept.

Course Content

1. Estimation of total ash
2. Estimation of minerals -demo
3. Determination of thermal inactivation time of enzymes in fruits and vegetables.
4. Estimation of crude fiber
5. To determine effect of temperature on taste
6. Extraction and analysis of pigments (Chlorophyl, Lycopene, Carotenoids)
7. Extend of non-enzymatic browning by extraction methods.
8. Extraction of polyphenols from foods by different methods
9. Estimation of total phenolic content
10. Estimation of total flavonoid content
11. Estimation of total antioxidant activity
12. Estimation of ferric reducing power

Course Outcomes: 1. Ability to isolate and identify the different pigments present in different food products.

2. Ability to isolate and identify polyphenols.
3. ability to estimate the mineral content in different food
4. Ability to determine the effect of temperature on tase.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	2	2	2	2
PO2	1	1	1	1
PO3	2	3	3	3
PO4	3	3	3	3
PO5	2	2	2	2

BSFT226-21: TECHNOLOGY OF MEAT, FISH AND POULTRY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objectives:

1. To understand the importance of livestock, egg and poultry industry.
2. To describe structure, composition and nutritional quality of animal products.
3. To illustrate the processing technology and value addition of meat, fish and poultry products.

Course Content

1. Quality evaluation of fish/prawn.
2. Subjective evaluation of Fresh Fish.
3. Cut out examination of canned fish (Sardine, Mackerel, Tuna).
4. Fish product formulation/canning.
5. Estimation of moisture content of meat.
6. Cutout analysis of canned meats/retort pouches.
7. Estimation of protein content of meat.
8. Analysis of frozen meat/meat emulsion products.
9. To study shelf-life of eggs by different methods of preservation.
10. Evaluation of eggs for quality parameters (market eggs, branded eggs).
11. To perform freezing of yolk/albumen.
12. Meat/Egg product formulation.

Course Outcomes:

1. Understand the technology for quality evaluation and formulation of fresh, canned fish.
2. Student shall be well versed with quality parameters of eggs, meat and meat products.
3. Student will be able to understand practical implication of above products.
4. Prepare various value-added products

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	1
PO2	2	1	2	2
PO3	1	1	2	1
PO4	2	1	2	2
PO5	1	1	1	2

BMPD402-18 MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	1	0	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

7. Sports/NSS/NCC
8. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department

DISCIPLINE SPECIFIC ELECTIVES

BSCDSE-101-21 FOOD SAFETY

Total Marks: 100	L	T	P
	4	0	0

Course objective: To understand the concept of food safety, types of hazards, causes and their management.

UNIT I

Introduction to Food Safety: Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting Food Safety, Importance of Safe Foods

Food Hazards of Physical and Chemical Origin: Introduction, Physical Hazards with common examples, Chemical Hazards (naturally occurring, environmental and intentionally added), Packaging material as a threat, Impact on health, Control measures

Food Hazards of Biological Origin: Introduction, Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes, Seafood and Shell fish poisoning, Mycotoxins

UNIT II

Management of hazards: Need, Control of parameters, Temperature control, Food storage

Hygiene and Sanitation in Food Service Establishments: Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Personnel Hygiene

UNIT III

Food Safety Management Tools: Basic concept, Prerequisites- GHPs ,GMPs, HACCP, introduction about ISO 9000, 22000, 14000 series

TQM - concept and need for quality, components of TQM, Kaizen. Risk Analysis, Accreditation and Auditing

UNIT IV

Microbiological criteria: Microbiological standards and limits (for processed food, water), Sampling, Basic steps in detection of food borne pathogens, Water Analysis

Food laws and Standards: Indian Food Regulatory Regime, Global Scenario, Other laws and standards related to food

Recent concerns: New and Emerging Pathogens, Genetically modified foods \ Transgenics, organic foods, Newer approaches to food safety.

Recommended readings:

1. Singh, S. P. (2009). Food Safety, Quality Assurance and Global Trade: Concerns and Strategies: International Book Distributing Co. Lucknow.
2. Metha, R. & George, J. (2005). Food Safety regulation concerns and trade: A Developing Country Perspective.
3. Pomeranz, Y. & Meloan, R. (1995). Food Analysis: Theory and Practice: AVI Publication, New York.
4. Askar, A. & Treptow, H. (1993). Quality assurance in Tropical Fruit Processing.
5. Mahindru, S. N. (2000). Food Safety: A Techno-legal Analysis: Tata Mc, India.
6. Lawley, R., Curtis L. and Davis,J. The Food Safety Hazard Guidebook , RSC publishing, 2004
7. De Vries. Food Safety and Toxicity, CRC, New York, 1997
8. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
9. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000
10. Forsythe,S.J.The Microbiology of Safe Food , second edition, Willey- Blackwell,U.K.,2010
11. Mortimore S.and Wallace C.HACCP,A practical approach,Chapman and Hill,London,1995
12. Blackburn CDW and Mc Clure P.J.Food borne pathogens. Hazards,risk analysis & control.CRC Press,Washington,U.S.A, 2005

Course outcome

1. Determination of various type of hazards (biological, chemical, physical).
2. Understanding different factors that contribute to food-borne illness and proper application of food handling techniques that will eliminate possible food-borne illness.
2. Understanding the concept and importance of hygiene, and sanitation
3. Understanding about food safety management tools (GHPs, GMPs, HACCP, ISO series) and laws.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	1
	PO4	1	1	1	2
	PO5	1	2	1	1

BSCDSE-102-21 FOOD SAFETY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To understand about the examination, analysis of food safety hazards and their management.

Course Content

1. Preparation of different types of media (complex, differential and selective)
2. Enumeration of aerial microflora using PDA
3. Identification of Molds by lactophenol blue staining
4. Negative Staining
5. Microbiological Examination of food
6. Bacteriological Analysis of Water by MPN method
7. Assessment of surface sanitation by swab and rinse method
8. Assessment of personal hygiene
9. Implementation of GHP
10. Implementation of HACCP

Course outcome

1. Understanding about different media preparation
2. Understanding the microbiological examination of food.
3. Understanding the importance of personal hygiene maintenance.
4. Understanding personal hygiene procedures with regard to food handling

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	2
	PO2	1	1	1	1
	PO3	1	1	1	1
	PO4	1	2	2	1
	PO5	1	1	1	1

BSCDSE-103-21 FOOD QUALITY MANAGEMENT

Total Marks: 100	L	T	P
	4	0	0

Course objective: To teach understanding about importance of quality in food sector, deteriorating factors and management strategies.

UNIT I

Food Quality Management: Introduction to food quality management – Definition of quality, quality concepts, quality perception, quality attributes. Concepts of quality management: Objectives, importance and functions of quality control and quality assurance; Quality management systems in India. Quality in the Agri- food production chain-Techno-managerial approach, food quality relationship and food quality management functions. Dynamics on the agri- food production chain, core developments in food quality management.

UNIT II

Contamination in Food Chain: Contamination in Food: Physical, chemical contaminants (heavy metals, pesticide residues, antibiotics, agrochemicals, veterinary drug residues, environmental pollutants, radionucleides, solvent residues, chemicals) and Natural toxins. Contaminants formed during processing & packaging – nitrosamines, acrylamide, alloys, benzene, dioxins and furans, persistent organic pollutants, polymers, etc. Chemicals from processing such as fumigants, autoxidation products, carcinogens in smoked foods,; intentional and unintentional additives.

UNIT III

Food Additives: Risk assessment studies- Safety and quality evaluation of additives and contaminants, Acute and chronic studies, NOEL, ADI, $LD_{50.}$ Introduction, need of food additives in food processing and preservation. Characteristics and classification of food additives. Antimicrobial agents. -Nitrites, sulphides, sulphur di oxide, sodium chloride, hydrogen peroxide. Antioxidants - Introduction, mechanism of action, natural and synthetic anti- oxidants, technological aspect of antioxidants. Sweeteners- Introduction, importance, classification- natural and artificial, chemistry, technology and toxicology, consideration for choosing sweetening agents. Colors- Introduction, importance, classification- natural, artificial, and natural identical, FD&C Dyes and Lakes. Use of plant tissue culture, polymeric colors etc for color

UNIT IV

Basic principles and application of processing techniques: High fructose corn syrup, cryogenic freezing, supercritical fluid extraction, fat mimetics, flavour encapsulation, use of nano technology in foods etc.

Recommended Readings

1. Pieternel A, Luning, Willem J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen,2009.
2. Brannen and et al., Food Additives, Marcel Dekker, New York,1990
3. Jones JM, Food Safety, Eagan Press, 1992
4. Shapton DA and Shapton NF, Principles and Practices for the safe processing of Foods. CRC Press, 1998
5. DeMan, 3rd edition, Principles of Food Chemistry, Springer, 2007.
6. Carol E. Steinhart, M. Ellin Doyle, Food Safety, Food Research Institute, Marcel Dekker, Inc., New York : 1995

Course outcome

1. Understand various areas of Food Safety & Quality
2. Understand about the quality assessments of food products.
3. Comprehend food quality managements systems.
4. Implementation of food safety & quality assurance.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	2
	PO2	1	1	1	1
	PO3	1	1	2	1
	PO4	1	1	1	1
	PO5	1	1	1	2

BSCDSE-104-21 FOOD QUALITY MANAGEMENT (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To develop understanding about analysis and estimation of different quality deteriorations in different foods.

Course Content

1. Qualitative tests for hydrogenated fats, butter, and ghee.
2. Quality inspection of various food stuffs- cereals, pulses, spices and condiments etc.
3. Estimation of sulphur dioxide in foods
4. Chromatographic estimation of colour.
5. Analysis of edible common salt for moisture content, MIW and total chlorides.
6. Estimation of ammonia nitrogen in water.
7. Estimation of benzoic acid/ sorbic acid in foods.

Course outcome

1. Understand the practical application of food safety and quality assurance in raw and processed foods.
2. Apprehend the quality assessment of food products using various instruments.
3. Perceive the sensory evaluation techniques.
4. Comprehend the detection methods of the adulterants in food products.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	2	1	1
	PO5	1	2	2	1

BSCDSE-105-21 BAKERY TECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Course objective: To create knowledge about the processing and quality evaluation of bakery products.

UNIT I

BAKERY INDUSTRY: Current status, growth rate, and economic importance of Bakery Industry in India. Product types, nutritional quality and safety of products, pertinent standards & regulations.

BREAD, BUNS AND PIZZA BASE: Ingredients & processes for breads, buns, pizza base, Equipments used, product quality characteristics, faults and corrective measures

UNIT II

CAKES: Ingredients & processes for cakes, Equipments used, product quality characteristics, faults and corrective measures. Different types of icings.

UNIT III

BISCUITS, COOKIES & CRACKERS: Ingredients & processes, Equipments used, product quality characteristics, faults and corrective measures.

UNIT IV

MODIFIED BAKERY PRODUCTS: Modification of bakery products for people with special nutritional requirements e.g. high fibre, low sugar, low fat, gluten free bakery products.

BREAKFAST CEREALS, MACARONI PRODUCTS AND MALT: Production and quality of breakfast cereals, macaroni products and malt.

Recommended Readings:

1. Dubey, S.C. (2007). Basic Baking 5th Ed. Chanakya Mudrak Pvt. Ltd.
2. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
3. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
4. Barndt R. L. (1993). Fat & Calorie – Modified Bakery Products, Springer US.
5. Samuel A. Matz (1999). Bakery Technology and Engineering, PAN-TECH International Incorporated.
6. Faridi Faubion (1997). Dough Rheology and Baked Product Texture, CBS Publications.
8. Samuel A. Matz (1992). Cookies & Cracker Technology, Van Nostrand Reinhold

Course outcome

1. Understanding about bakery products.
2. Understanding about appropriate equipment for the production of baking goods.
3. Understanding about various ingredients, and their uses.
4. Understanding about baking techniques utilizing safe and hygienic working practices.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	1	1
	PO3	1	1	1	1
	PO4	1	1	1	1
	PO5	1	2	2	1

BSCDSE-106-21 BAKERY TECHNOLOGY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To develop understanding about production of different bakery products and equipments involved.

Course Content

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

Course outcome

1. Understanding about proper production stages for different products.
2. Understanding fundamental baking techniques.
3. Understanding about interpreting recipes for the intended outcome.
4. Understanding bakeshop terminology appropriately.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	1	1
	PO3	1	2	1	1
	PO4	1	1	1	1
	PO5	1	1	1	2

BSCDSE-107-21 FOOD PACKAGING

Total Marks: 100	L	T	P
	4	0	0

Course objective: To develop understanding about importance, factors affecting, types of packaging in food relam.

UNIT I

Introduction to Food Packaging: Packaging Functions and Requirements,, Printing of packages .Barcodes & other marking, Labeling Laws Glass: Composition, Properties, Methods of bottle making, Types of closures. Introduction to smart and intelligent packaging

UNIT II

Food Packaging Materials: Paper and paper-based materials, corrugated fiber board (CFB).
Plastics, formation- Injection molding, Blow molding, Types of plastics, Lamination, Biodegradable plastics, Edible packaging and Bio-composites. Environmental Concerns- recycling and disposal of plastic waste.
Metal packaging- Metals: Tinplate, tinning process, components of tinplate, tin free can (TFC), types of can, metallic films, lacquers

UNIT III

Package Designing for Foods: Package design for fresh horticultural produce and animal foods, dry and moisture sensitive foods, frozen foods, fats and oils, thermally processed foods and beverages.

UNIT IV

Testing and Regulatory Aspects of Food Packaging: Testing Procedures for Packaging Materials- thickness, tensile strength, puncture resistance, bursting strength, seal strength, water vapor permeability, CO_2 permeability, oxygen permeability, grease resistance, Testing Procedures for Packaged Foods - Compatibility and shelf life studies, evaluation of transport worthiness of filled packages. Food Packaging Laws and Regulations.

Packaging Machinery and Systems: Bottling machines, Cartoning systems, Seal and Shrink packaging machine; Form, Fill and Sealing machine (FFS).

Vacuum, Controlled and Modified atmosphere packaging systems; Aseptic packaging systems; Retort packaging, Active and Intelligent packaging systems

Recommended readings:

1. Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group,2012
2. Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic and Professional, 1992
3. Coles R, McDowell D, Kirwan MJ Food Packaging Technology. Blackwell, 2003

Course outcome

1. Comprehend advance knowledge on the properties and production of various packaging materials.
2. Understand the concept of package designing for foods.

3. Learn about consumer response about new packaging systems and safety and legislative requirements
4. Acquaint about food-package interaction between package-flavor, gas storage systems for food storage, recycling and use of green plastics for reducing the pollution and their effect on food quality.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	1	1	1
	PO5	1	1	2	1

BSCDSE-108-21 FOOD PACKAGING (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: The course aims to develop the student's practical knowledge in packaging of foods

Course Content

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 outcome

1. Understand different types of food packaging materials.
2. Aware of symbols used in food industries.
3. Understand the role and effectiveness of various packaging systems.
4. Shelf life evaluation of packaged foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	3	1	1
	PO5	1	1	3	1

BSCDSE-109-21 NUTRACEUTICALS AND FUNCTIONAL FOODS

Total Marks: 100

L	T	P
4	0	0

Course objective: To teach basic understanding of the concepts of nutraceuticals and functional foods and their use for managing chronic diseases.

UNIT I

Introduction: Background, status of nutraceuticals and functional food market, definitions, difference between nutraceuticals and functional foods, types of nutraceutical compounds and their health benefits, current scenario.

UNIT II

Nutraceuticals: Types of nutraceutical compounds – Phytochemicals, phytosterols and other bioactive compounds, peptides and proteins, carbohydrates (dietary fibers, oligosaccharides and resistant starch), prebiotics, probiotics and synbiotics, lipids (Conjugated Linoleic Acid, omega-3 fatty acids, fat replacers), vitamins and minerals; their sources and role in promoting human health.

UNIT III

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 etc), Fermented foods – their health benefits and role in conditions like cardiovascular diseases, hypertension, diabetes etc. Future prospects of functional foods and nutraceuticals and their potential for use in improving health. Development in processing of functional foods. Formulation and fabrication of functional foods.

UNIT IV

Legal Aspects: Stability of nutraceuticals. Safety, Consumer acceptance and assessment of health claims, labeling, marketing and regulatory issues related to nutraceuticals and functional foods.

Recommended readings:

1. Wildman REC, Handbook of Nutraceutical and Functional Foods, CRC Press 2001
2. Ghosh D et al, Innovations in Healthy and Functional Foods, CRC Press 2012
3. Pathak YV, Handbook of nutraceuticals Volume 2, CRC Press 2011
4. Various journals of food technology, food science and allied subjects.

Course outcome

1. Acquire knowledge on various bio molecules showing health benefits.
2. Understand various physiological and biochemical aspects of life threatening and chronic diseases.
3. Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
4. Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program	Course Outcome (CO)				
		CO1	CO2	CO3	CO4

Outcome (PO)	PO1	1	1	1	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	1	3	1
	PO5	1	3	2	1

BSCDSE-110-21 NUTRACEUTICALS AND FUNCTIONAL FOODS (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To develop practical knowledge about analysis of important compounds and development of new functional products.

Course Content

1. Identification of various nutraceuticals and functional foods available in the market
2. Estimation of chlorophyll content of green vegetable
3. Determination of lycopene in fruit/vegetable
4. Determination of total pectin in plant material
5. Estimation of crude fibre/dietary fibre content in cereals and their products
6. Estimation of anthocyanins in food sample
7. Preparation and evaluation of probiotic/prebiotic foods

Course outcome

1. Acquire knowledge on various nutraceutical components and their health benefits.
2. Understand various extraction and estimation methods of nutraceuticals.
3. Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
4. Study and demonstrate various aspects regarding safety, quality and toxicology of food products including, nutraceutical and functional foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	2
	PO2	1	2	1	1
	PO3	1	1	1	2
	PO4	1	2	1	1
	PO5	1	1	3	2

BSCDSE-111-21 FOOD PLANT SANITATION

Total Marks: 100	L	T	P
	4	0	0

Course objective: To develop knowledge and importance of food plant sanitation.

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, filtration, centrifugation, distillation and, gas absorption equipments.

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, Principles of Cold Chain Creation and Management. Physicochemical changes in stored products during storage, Air tight, Non-air tight, Under ground, 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

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.
By-products utilization obtained from dairy plant, egg& poultry processing industry and meat industry.

UNIT IV

Wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.

Recommended Readings:

1. Norman G. Marriott and Robert B. Gravani. (2006). Principles of Food Sanitation,5th edition
2. Rao, D. G. (2010). Fundamentals of Food Engineering, PHI learning Private Ltd.
3. Fellows P. (2000). Food Processing Technology, 2nd Edition. Woodhead Publishing Limited and CRC Press LLC
4. James A (2013) The supply chain handbook, distribution group.
5. FAO, US (1984) Design and operations of cold store in developing

Course outcome

1. Understanding about how the contamination of food can occur in a food service establishment.
2. Understanding about the effect and consequences of food borne illness.
3. Apprehending about sound practices to prevent the possibility of food poisoning.
4. Identify measures/procedures that will reduce or eliminate accidents in food preparation and service areas.
5. Gain knowledge of plant designing and layout.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	2
	PO2	1	1	1	1
	PO3	1	1	3	1
	PO4	1	1	2	2
	PO5	1	2	1	1

BSCDSE-112-21 FOOD PLANT SANITATION (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To develop understanding and practical implementation regarding food plant sanitation.

Course Content

1. Design and layout of various food processing systems and food service areas.
2. Design and layout of cold storage and warehouse.
3. Determination of physico-chemical properties of wastewater.
4. Preparation of a sanitation schedule for food preparation area.
5. Testing of sanitizers and disinfectants.
6. Study of Phenol coefficient of sanitizers.
7. Determination of BOD (biological oxygen demand)/ COD in waste water.
8. Study of waste water treatment system/ETP.

Course outcome

1. Understanding about the concept of design and layout of cold storage and warehouse.
2. Understanding about the characteristics/properties of refuse.
3. Understanding suitable methods of solid and liquid waste disposal and state their advantages
4. Identify potential hazards of improper waste disposal

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	3	1	1
	PO3	1	1	1	2
	PO4	3	1	3	1
	PO5	1	3	2	1

SKILL ENHANCEMENT ELECTIVE COURSES

BSCSEC-101-21 ENTREPRENEURSHIP DEVELOPMENT

Total Marks: 50(30 Internal + 20 external)	L	T	P
	0	0	2

Course objective: Purpose of the course is that the students acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities

UNIT I

ENTREPRENEURIAL DEVELOPMENT: Case studies of successful entrepreneurs; Exercises on ways of sensing opportunities – sources of idea, creating efforts, SWOT Analysis; Entrepreneurial skill assessment test; Techniques of development of entrepreneurial skills, positive self image and locus of control

UNIT II

FOOD BUSINESS MANAGEMENT: Case studies of Food Processing Business and its aspects; Business opportunity Identification and Assessment techniques; Business Idea Generation and evaluation exercise; Market Assessment study Analysis of competitive situation; SWOT Analysis for business and for competitors; Preparation of business plan; Preparation of project report; Methods of Arrangement of inputs – finance and material.

Recommended Readings

1. Vasant Desai (2012) Fundamentals of Entrepreneurship and Small Business Management, Himalya Publishing House Pvt. Ltd., Mumbai
2. Vasant Desai (2011) The Dynamics of Entrepreneurial Development and Management, Himalya Publishing House Pvt. Ltd., Mumbai
3. D. David and S Erickson (1987) Principles of Agri Business Management , Mc Graw Hill Book Co., New Delhi.
4. Acharya S S and Agarwal N L (1987) Agricultural Marketing in India, Oxford & ISH Publishing Co., New Delhi.
5. David H. Holt (2002) Entrepreneurship – Anew Venture Creation, Prentice Hall of India, New Delhi.
6. Phill Kottler (1994) Marketing Management, Prentice Hall of India Private Limited, New Delhi.
7. Chandra, Prasanna (1996) Projects, Planning, Analysis, Selection, Implementation and Review, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course outcome

1. Understand theories of entrepreneurship and business development
2. Understand the key resources required to develop an existing business such as ideas and finance, launch a new venture, or initiate a business enterprise
3. Understanding to state, understand and evaluate the key factors needed to develop a successful business
4. Understand the central role of opportunity recognition and marketing to business development • Understand the creation of business sustainability

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	2
	PO2	1	2	1	1
	PO3	1	3	1	2
	PO4	1	1	1	1
	PO5	1	3	1	1

BSCSEC-102-21 FOOD PRODUCT DEVELOPMENT (LAB)

Total Marks: 50(30 Internal + 20 external)

L	T	P
0	0	2

Course objective: Students will gain a wide range of knowledge and skills that can be applied for the improvement or development of food products to satisfy consumers' changing demands and to improve business related outcomes

PROJECTS

Development of New Product: Definition, Importance , objectives &Need of product development, Reasons of failure, Types and Steps of product development ,Product development Tools and their use

Projects on:

1. Market and literature survey to identify the concepts of new productsbased on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods.
2. Screening of product concept on the basis of techno-economic feasibility.
3. Development of prototype product and Standardization of formulation process.
4. Proximate Analysis of New Product
5. Packaging, labeling and shelf-life studies
6. Cost analysis and Final Project Report

Each team/group of students would develop a food product on the basis of above mentioned lines /steps and would submit a project report

Recommended Readings

1. Fuller, Gordon W. 2004. New Product Development- From Concept to Marketplace, CRC Press.
2. Anil Kumar, S., Poornima, S.C., Abraham, M.K.& Jayashree, K.2004. Entrepreneurship Development. New Age International Publishers.
3. Moskowitz, Howard and Saguy ,R. I. Sam 2009. An Integrated Approach to New Food Product , CRC Press.

Course outcome

1. Understanding the role of food trends in the new product development process.
2. Understanding about designing a food product through the application of knowledge of food ingredients and functional foods.
4. Understanding about designing and applying packaging to food products and evaluate product quality and sensory properties.

Formulation of Course Outcomes-Program Outcomes matrix

Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	2
	PO2	1	1	1	1
	PO3	2	2	1	1
	PO4	3	1	2	1
	PO5	1	1	1	2

BSCSEC-103-21 FOOD FERMENTATION TECHNOLOGY (LAB)

Total Marks: 50(30 Internal + 20 external)	L	T	P
	0	0	2

Course objective: Develop understanding about different technical, biochemical and microbial systems involved in various food and beverage fermentations.

Course Content

1. Food Fermentation Technologies.
2. Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery.
3. Starter cultures.
4. Production of Baker's Yeast
5. Production of yoghurt using DIV cultures
6. Development of a fermented food/drink utilizing plant products /animal products or byproducts as substrate

Recommended Readings

1. Industrial Microbiology by Prescott & Dunn, CBS Publications, New Delhi.
2. Industrial Microbiology by L.E. Casida, New Age Publications, New Delhi.
3. Principle of Fermentation Technology by Whittaker and Stanbury, Aditya Books Pvt.Ltd.
4. Handbook of Indigenous Fermented Foods by K.H. Steinkrus
5. Food Microbiology by Adams and Moss, Panima Pubilication Carporation, Delhi.
6. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi V. K. & Pandey, A., Sanjanya Books 1999.
7. Essentials of Food Microbiology. Edited by John Garbutt. Arnold International Students Edition. 1997
8. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.Elsiever Applied Science Publication.1997
9. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall. 1995., Pergaman. McNeul and Harvey. (AC) NEW

Course outcome

1. Puts emphasis on the basic engineering principles of Fermentation Technology.
2. Understanding about application of fermentation in food and biotechnological industry.
3. Understanding fermentation – dairy, meat, fruit and vegetable products
4. Combine theoretical knowledge and practical skills to reproduce existing products

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	2	1
	PO3	2	1	1	2
	PO4	3	3	2	1
	PO5	1	1	1	1

BSCSEC-104-21 CONFECTIONARY TECHNOLOGY (LAB)

Total Marks: 50(30 Internal + 20 external)	L	T	P
	0	0	2

Course objective: To develop understanding about production, ingredients and equipments involved in confectionary technology.

Course Content

Sugars- Types and sources, methods of preparation of sugars, jaggery, khandsari, raw and refined sugar. Principles of sugar cookery, crystalline and non-crystalline candies.

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.

1. Determine the effect of heat on sugar solution and perform the thread and cold water test.
2. To study the process of inversion, melting and caramelization in sucrose.
3. Preparation of fondant, fudge and brittles.
4. Preparation of *Shakarpara* and *Chhana murki*.
5. Preparation of candy and toffee and to perform quality assessment tests.
6. Preparation of cake decorations.

Recommended Readings:

1. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
2. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
3.Beckette S.T. (2009). Industrial Chocolate Manufacture, Blackwell Publishing Ltd.
4.Minifie B.W. (1999). Chocolate, Cocoa and Confectionary, Aspen Publication.
5. Mohini Sethi, Eram Rao (2011) Food science- Experiments and applications, 2nd ed., CBS publishers &Distributors pvt ltd.

Course outcome

1. Understand about significance and healthy aspects of confectionery and snack food in our daily life.
2. Understand status of confectionery and snack foods industries.
3. Knowledge about the manufacturing of various sugar confections, bakers' confections and snack foods.
4. To know about importance of packaging and quality maintenance of confectionery and snack foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	2	3	2	2
	PO4	1	1	1	1
	PO5	1	1	1	1

BSCSEC-105-21 PROJECT AND TECHNICAL REPORT (LAB)

Total Marks: 50 (30 Internal + 20 external)	L	T	P
	0	0	2

Course objective: To develop understanding technical report writing.

Course Content

Introduction: Project - definition, features, types, infrastructure creation-a special type of projects, significance of infrastructure in economic development, Project Identification: Idea generation, Project screening, Feasibility study. The advantages and disadvantages of starting your business. Project Appraisal : technical appraisal, marketing appraisal, legal and environment appraisal, financial appraisal-cost estimation of the project and Detailed project report – introduction. Arrangement of funds

Projects & technical report on:

1. Screening of product concept on the basis of techno-economic feasibility.
2. Development of prototype product and Standardization of formulation process.
3. Proximate Analysis of New Product
4. Final Project Report

Each team/group of students would develop a technical project report on the basis of above mentioned lines /steps and would submit a project report

Recommended Readings:

1. John Kao, Creativity & Entrepreneurship
2. P. Chandra, Projects planning analysis selection implementation & review
3. P.Gopalkrishnan & V.E. Ramamoorthy, Text book of Project management
4. N. Singh , Project management & control, (Himalaya pub.)
5. B.M. Patel , Project management , (Vikas Pub.) 2000

Course outcome

1. Understanding about the stages of the writing process (prewriting/writing/rewriting) and apply them to technical and workplace writing tasks.
2. Understanding about producing a set of documents related to technology and writing in the workplace.
3. Understanding about basic components of definitions, descriptions, process explanations, and other common forms of technical writing.
4. Students will be familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	1	1	1
	PO5	1	1	1	1

I.K. Gujral Punjab Technical University
B.Sc. (Hons) Food Technology, Batch 2021 onwards

GENERIC ELECTIVE

(FOR OTHER DEPARTMENT STUDENTS)

BSCGE-101-21 FOOD PROCESSING AND PRESERVATION

Total Marks: 100	L	T	P
	4	0	0

Course objective: To develop understanding about techniques, and modern tools necessary food processing and preservation operations

UNIT I

FOOD PROCESSING OPERATIONS:

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; Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.

Dehydration: Normal drying curve , effect of food properties on dehydration ,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.

Thermal Processing of Foods: Classification of thermal processes, Principles of thermal processing, commercial canning operations, Aseptic Processing, UHT.

Irradiation and microwave heating: Principles, Dosage, Applications of Irradiation, Mechanism of microwave heating and applications.

UNIT II

TECHNOLOGY OF COLLOIDS IN FOOD: 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

WATER DISPOSAL AND SANITATION: Waste water ,hardness of water, break point chlorination, physical and chemical nature of impurities, BOD, COD, waste water treatment, milk plant sanitation, CIP system, sanitizers used in food industry.

MINIMAL PROCESSING AND HURDLE TECHNOLOGY

UNIT IV

FOOD ADDITIVES, CONTAMINANTS AND REGULATIONS: Food Additives - Introduction, need of food additives in food processing and preservation, Characteristics and classification of food additives, Chemical, technological and toxicological aspects. Contamination in Food- : Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionucleides, solvent residues, chemicals) Natural toxins.Food Laws and Regulations- Codex, HACCP, ISO, FSSA etc.

Recommended Readings:

1. Potter NH,1998, Food Science, CBS Publication, New Delhi
2. Ramaswamy H and Marcotte M,2009, Food Processing Principles and Applications CRC Press
3.Deman JM,2007, Principles of Food Chemistry, 3rd ed.Springer
4. Manay NS and Shadaksharaswamy M,1987, Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi

Course outcome

1. To impart knowledge on the causes of food spoilage.
2. To learn principles of different techniques used in processing and preservation of foods.
3. To identify and select preservation methods appropriate for specific foods and learn the effects of preservation methods on the quality of food.
4. To learn different permitted food additive used in food industry.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	2	1	1
	PO3	1	1	1	3
	PO4	2	2	3	1
	PO5	1	1	1	3

BSCGE-102-21 FOOD PROCESSING AND PRESERVATION (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To develop skill and knowledge regarding food preservation and processing operations.

Course Content

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 outcome

1. To impart knowledge on the principles of different techniques used in processing and preservation of food.
2. Identification and selection of preservation methods appropriate for specific foods and to learn the effects of preservation methods on the quality of food.
3. Understanding the concept of heat and chilling based preservation approaches.
4. Understanding, implementation and effect analysis of minimal processing on different foods.

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	2	1
	PO3	1	2	1	2
	PO4	1	2	2	1
	PO5	1	1	1	2

BSCGE-103-21 CHEMISTRY OF FOOD

Total Marks: 100	L	T	P
	4	0	0

Course objective: To acquaint the students about chemistry of various foods.

UNIT I

Introduction: Introduction to Food Chemistry, Composition of food

Water : Definition of water in food, Structure of water and ice, Types of water, Role of water activity

Lipids: Classification of lipids, Physical and chemical characteristics, Chemical deterioration of fats and oils (auto oxidation, rancidity, lipolysis, flavor reversion)

UNIT II

Proteins: Protein classification and structure, types of food proteins (plant and animal proteins), Physicochemical and functional properties of proteins

Carbohydrates: Classification, Structure and Chemical reactions of carbohydrates

UNIT III

Vitamins: Types (Water soluble vitamins and Fat soluble vitamins)

Flavour: Definition and basic tastes, Description of some common food flavors.

Minerals: Major and minor minerals, Toxic minerals in food

UNIT IV

Natural Food Pigments: Introduction and classification, Types of food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

Browning Reactions in Food: Types, Enzymatic and Non enzymatic Browning and their control measures

Enzymes: Introduction, classification, General characteristics, Important enzymes in food processing

Physico-chemical and nutritional changes occurring during food Processing

New Food Product Development: Introduction, need, objectives and types

Recommended Readings:

1. DeMan, John M.1982. Principles of Food Chemistry ,3rd Ed., Springer

2. Desrosier, Norman W. and Desrosier.,James N.1977.The technology of food preservation , 4th Ed.,Westport, Conn. : AVI Pub. Co.
3. Fennema, Owen R1996. Food Chemistry, 3rd Ed., Marcell Dekker, New York,
4. Whitehurst and Law.2002. Enzymes in Food Technology, CRC Press, Canada
5. Wong, Dominic WS.1885. Food Enzymes, Chapman and Hall, New York
6. Potter,N.N.and Hotchkiss,J.H.1995. Food Science5th Ed., Chapman & Hall

Course outcome

1. Students are expected to understand and be able to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications.
2. To understand how the properties of different food components and interactions among these components modulate the specific quality attributes of food systems
3. To understand the principles that underlines the biochemical/enzymatic techniques used in food analysis
4. Chemistry relating to major and minor components of food**,** their nutritional, physiological, sensory, flavor and microbiological aspects.

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	2	1	1
	PO3	1	3	3	2
	PO4	1	2	1	1
	PO5	1	1	1	2

BSCGE-104-21 CHEMISTRY OF FOOD (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To develop knowledge regarding analysis and estimation of chemical components critical in food realm.

Course Content

1. Preparation of primary and secondary solutions
2. Estimation of moisture content
3. Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR
4. Determination of percent free fatty acids
5. Estimation of Peroxide Value
6. Estimation of Total Ash
7. Estimation of Protein Content

Course outcome

1. Ability to use terminology, appropriate to the field of food chemistry, correctly and contextually.
2. Experimental planning, the preparation of reagents and use of basic instrumentation (spectrophotometers, viscometers, color meters, chromatographic apparatus etc), the collection of experimental data and its presentation, analysis and interpretation
3. Capacity to formulate foods that are designed to address and contribute to reducing community health concerns.
4. Learning chemical aspect of major and minor components of food

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	3
	PO2	1	1	1	1
	PO3	1	2	2	2
	PO4	1	3	2	1
	PO5	1	3	1	1

BSCGE-105-21 SENSORY EVALUATION OF FOOD

Total Marks: 100

L	T	P
4	0	0

Course objective: To acquaint the students about sensory analysis of various foods.

UNIT I

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 II

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 – primitive to recent techniques. Merits and demerits of each method. Olfactory abnormalities

UNIT III

Colour: Introduction and importance of colour. Dimensions of colour and attributes of colour, appearance factors, gloss etc. Perception of colour. Colour abnormalities; Measurement of colour; Munsell colour system, CIE colour system, Hunter colour system, spectrophotometry and colorimetry etc.

UNIT IV

Texture: 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

Recommended Readings

1. Rao E. S. (2013). Food Quality Evaluation, Variety Books.
2. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.
3. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999
4. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer. 62
5. Brannen and et al.,(1990)Food Additives, Marcel Dekker,New York,1990

Course outcome

1. To understand about sensory evaluation scales (Hedonic rating, Ranking difference, Triangle test).
2. To understand about importance and evaluations of taste, odor, color and texture.
3. To understand benefits and limitations (scientific and ethical) of the sensory evaluation of food and be able to recommend, justify and critique commonly used methods of sensory analysis.
4. Understanding about modern tools *viz.* e-nose, e-tongue

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	2	1	2
	PO4	1	2	1	1
	PO5	1	2	2	1

BSCGE-106-21 SENSORY EVALUATION OF FOOD (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To understand the practical knowledge about sensorial analysis methods.

Course Content

1. Training of sensory panel.
2. To perform recognition and sensitivity tests for four basic tastes.
3. To perform analytical tests of sensory evaluation.
4. Recognition tests for various food flavors, flavor defects in milk.
5. Sensory evaluation of milk and milk products.
6. Texture evaluation of various food samples- crispies/ cookies/ biscuits/ snack foods
7. Measurement of color by using Tintometer/ Hunter Colour Lab etc.
8. Qualitative tests for hydrogenated fats, butter, ghee
9. Platform tests for milk
10. Quality evaluation of various food stuffs- cereals, pulses, honey, jaggery, sugar, tea, coffee etc.

Course outcome

1. Understanding about identification solutions to problems related to the sensory analysis of food and to apply and expand upon the theoretical concepts presented in lectures.
2. Understanding about conceptualizing food formulations that meet specified sensory requirements and which are intended to contribute to reducing community health concerns.
3. Understanding about implementation of a test plan.
4. Practical application in various raw and processed products.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	2	1	2
	PO4	3	2	2	1
	PO5	1	2	1	2

BSCGE-107-21 FOOD MICROBIOLOGY AND FOOD SAFETY

Total Marks: 100	L	T	P
	4	0	0

Course objective: To understand the role and significance of microbes of different categories, microbial inactivation and environmental factors that affect them in foods.

UNIT I

Introduction to Food Microbiology: History and Development of Food Microbiology, Definition and Scope of food microbiology

Types of Microorganisms in Food: Classification and Nomenclature, Morphology and Structure Importance in food (bacteria, fungi and viruses) Significance of spores

Microbial Growth in Food: Bacterial growth curve, Factors affecting the growth of micro organisms in food

UNIT II

Microbial Food Spoilage: Sources of Microorganisms in foods, Some important food spoilage bacteria, Spoilage of some specific food groups

Food Fermentations: Fermentation –definition and types, Microorganisms used in food fermentations, Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, yoghurt , soya sauce, wine and traditional Indian foods

Food borne Diseases: Types – food borne infections, food borne intoxications and toxin infections, Origin, symptoms and prevention of some commonly occurring food borne diseases

UNIT III

Enumeration techniques & control of microorganisms in foods: Qualitative and quantitative methods-conventional as well as rapid, Principles and methods of preservation (thermal and non thermal),Introduction to Hurdle Technology

Introduction to Food Safety: Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting Food Safety

UNIT IV

Hygiene and Sanitation in Food Service Establishments: Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Personnel Hygiene

Food Safety Management Tools: Basic concept, Prerequisites, HACCP, ISO series, TQM and Risk Analysis

Recommended Readings:

1. Frazier William C and Westhoff, Dennis C. 2004 Food Microbiology, TMH, New Delhi,
2. Jay, James M. 2000 Modern Food Microbiology, CBS Publication, New Delhi,
3. Garbutt, John.1997 Essentials of Food Microbiology, Arnold, London,
4. Pelczar MJ, Chan E.C.S and Krieg, Noel R 1993 Microbiology, 5th Ed., TMH, New Delhi
5. Lawley, R., Curtis L. and Davis,J. , 2004 The Food Safety Hazard Guidebook , RSC publishing.
6. De Vries, 1997, Food Safety and Toxicity, CRC, New York,
7. Marriott, Norman G. , 1985, Principles of Food Sanitation, AVI, New York,
8. Forsythe, S J , 1987,Microbiology of Safe Food, Blackwell Science, Oxford, 2000 65 &Sons; USA,

Course outcome

1. Understand the principles involving food spoilage and preservation involving microorganisms and explain why microbiological quality control programmes are necessary in food production.
2. Ability to identify the characteristics of spoilage causing and beneficial microorganisms in foods.
3. Understand the role and significance of intrinsic and extrinsic factors on growth of microorganisms in foods and differentiate which organisms would be likely to grow in a specific food product.
4. Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated killed or made harmless in foods and identify ways to control microorganisms in foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	2	1	1
	PO5	1	2	1	1

BSCGE-108-21 FOOD MICROBIOLOGY AND FOOD SAFETY (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To develop practical knowledge among students regarding microbiological analysis for ensuring food safety.

Course Content

1. Introduction to the Basic Microbiology Laboratory Practices and Equipments
2. Preparation and sterilization of nutrient broth and media
3. Morphological study of bacteria and fungi using permanent slides
4. Simple staining and Gram's staining
5. Standard Plate Count Method
6. Bacteriological Analysis of Water
7. Assessment of surface sanitation by swab/rinse method
8. Assessment of personal hygiene
9. Scheme for the detection of food borne pathogens
10. Implementation of FSMS – HACCP, ISO: 22000

Course outcome

1. Acquire the practical skills for the sampling of foods to carry out microbial analysis.
2. Ability to carry out various sterilization techniques and to identify the most suitable technique for specific food.
3. Ability to isolate and identify common food borne microbial pathogens.
4. Understand microbiological analysis methods for food products and ability to analyze different foods for presence of hazardous microorganisms using food microbiology technology.

Formulation of Course Outcomes-Program Outcomes matrix .

Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	1
	PO2	1	1	1	1
	PO3	1	1	3	3
	PO4	1	2	1	1
	PO5	1	2	1	1

BSCGE-109-21 FOOD ENGINEERING AND PACKAGING

Total Marks: 100

L	T	P
4	0	0

Course objective: To develop understanding about the techniques, principles, factors affecting the process of food engineering and packaging.

UNIT I

Unit Operations and Processes: Introduction, Units and Dimensions, Heat Transfer-Conduction, Convection and Radiation, Mass transfer-Diffusion, membrane separation processes, Steam generation and Boilers, Evaporation, Drying and dehydration, Refrigeration, Freezing, Psychometrics and Fluid flow.

Unit II

Separation and Size Reduction Processes: Principles and equipments used in separation Extraction, sedimentation, filtration, centrifugation, Size reduction – Milling, grinding and mixing of foods

Unit III

Introduction to Food Packaging: Course objectives and functions of food packaging, Requirements for effective food packaging, Types of packaging Materials, General properties of packaging materials

Unit IV

Packaging of Foods: Packaging of fresh produce and processed foods, Aseptic packaging, Advances in food packaging

Recommended Readings:

1.Paine FA and Paine HY, 1992 A Handbook of Food Packaging, Blackie Academic Professional,
2.Rao CG. 2006, Essentials of food process engineering. B S publications
3.Rao DG, 2010, Fundamentals of food engineering. PHI learning private Ltd.
4.Robertson GL, 2012, Food Packaging – Principles and Practice, CRC Press Taylor and FrancisGroup
5.Singh RP and Heldman DR, 1993, 2003, 2009, 2nd, 3rd and 4th Ed., Introduction to food engineering. Academic press.

Course outcome

1. To determine suitable methods of processing techniques for a chosen food.
2. To understand the operations involved in packaging material manufacture.
3. To develop an understanding of major packaging materials used in food packaging.
4. Understanding about packaging for different foods with respect to engineering aspect.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	2
	PO3	1	1	1	2
	PO4	1	2	1	1
	PO5	1	2	1	2

BSCGE-110-21 FOOD ENGINEERING AND PACKAGING (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To impart practical knowledge regarding food engineering process and packaging.

Course Content

1. Study the dehydration process
2. Study the freezing characteristics of foods
3. Study the process of evaporation
4. To design layout of a food plant
5. Determination of viscosity of foods
6. Identification of packaging materials
7. Testing of packaging materials
8. Demonstration of vacuum/gas packaging of foods

Course outcome

1. To understand the purpose and principles of food packaging
2. To impart knowledge of various areas related to food processing and packaging.
3. To evaluate the suitability of packaging material for a particular type of food.
4. Practical application on designing packaging for different foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	1
	PO2	1	1	3	1
	PO3	1	1	1	3
	PO4	1	2	2	1
	PO5	1	2	3	1

BSCGE-111-21 TECHNOLOGY OF PLANT AND ANIMAL FOODS

Total Marks: 100

L	T	P
4	0	0

Course objective: To impart knowledge regarding processing and preservation of plant and animal origin foods.

UNIT I

Technology of Fruits and Vegetables: Introduction and importance of fruit and vegetable preservation, history and need of preservation. Canning and bottling of fruits and vegetables: Selection of fruits and vegetables, process of canning, containers of packing, spoilage in canned foods. Fruits beverages: Introduction, process and preservation of fruit juices .Jams, jellies and marmalades: Processing and technology, defects in jelly. Pickles, chutneys and sauces: Processing, types, causes of spoilage in pickling. Tomato products: Selection of tomatoes, processing of tomato juice, tomato puree, paste, ketchup, sauce and soup, Dehydration of Fruits and Vegetables.

UNIT II

Technology of cereals, legumes and oilseeds: Wheat - Types, milling, flour grade. Rice – Variety, milling, parboiling. Corn – Variety, milling, Millets - milling. Pulses- Dry and wet milling, Oilseeds- Extraction of oil and refining.

Spices &Plantation Products: Spices - Processing and properties of important spices. Tea and Coffee: Processing

UNIT III

Dairy and Fish Technology : Dairy – FSSA Definition of Milk, Types of Market Milk, Physico-chemical properties of milk, processing of Milk, Concept of Filtration, Clarification, Homogenization, Pasteurization, Introduction to various Milk Products: Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, icecream, condensed milk, milk powder, channa, paneer, cheese (cheddar). Fish – Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical, Methods of Fish Preservationchilling, freezing, Drying, salting, smoking.

UNIT IV

Meat, Poultry and Egg Technology: Meat and Poultry – Definition of carcass, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat, Concept of an abattoir, Process of slaughtering in an abattoir. Egg – Structure and composition of hen's egg, egg proteins, characteristics of fresh egg, deterioration of egg quality. Preservation of eggs, Refrigeration and freezing, thermal processing, egg powder

Recommended Readings:

1. Girdharilal, Siddappaa, G.S and Tandon, G.L., 1998, Preservation of fruits & Vegetables, ICAR, New Delhi
2. Kent.N.L, 2003 , Technology of Cereal, 5th Ed. Pergamon Press
3. Chakraborty, 1988, Post Harvest Technology of Cereals, Pulses and Oilseeds, revised ed., Oxford & IBH Publishing Co. Pvt Ltd,
4. Marshall, 1994, Rice Science and Technology, Wadsworth Ed., Marcel Dekker, New York, 1994
5. H. Faride, 1997, The Science of Cookie and Cracker Production, CBS Publication, New Delhi, 1997 70 6. W B Crusess.2007,Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
7. Manay, S. 2004, & Shadaksharaswami, M., Foods: Facts and Principles, New Age Publishers,
8. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
9. De Sukumar, . 2007, Outlines of Dairy Technology, Oxford University Press, Oxford.
10. Lawrie R A, 1998,Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England,
11. Shai Barbut, 2005.,Poultry Products Processing,CRC Press 2005.
12. Stadelman WJ, Owen J Cotterill, 2002, Egg Science and Technology, 4th Ed. CBS Publication New Delhi
13. Hall GM, 1992,Fish Processing Technology, VCH Publishers Inc., NY, 1992

Course outcome

1. Understanding about sources, significance and classification of plant and animal source foods.
2. Understanding about methods of processing and preservation of different plant and animal foods.
3. Understanding about nutritive composition of plant and animal foods.
4. Understanding about the standards and regulations associated with different food categories.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	1
	PO2	1	1	2	1
	PO3	2	1	1	3
	PO4	2	1	2	1
	PO5	1	2	2	1

BSCGE-112-21 TECHNOLOGY OF PLANT AND ANIMAL FOODS (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To develop understanding about estimation and analysis of plant and animal foods.

Course Content

1 Physical Characteristics of Wheat
2 Estimation of gluten content of flour
3 Estimation of degree Brix:Acid ratio
4. Estimation of percent Ascorbic acid
5. Platform tests in milk (Acidity, COB, specific gravity)
6. Evaluation of eggs for quality parameters (market eggs, branded eggs)
7. Cut out examination of canned fish (Sardine, Mackerel, and Tuna)/Meat.
8 To prepare casein and calculate its yield.

Course outcome

1. Understanding about nutritive composition of different plant and animal source foods.
2. Understanding and application of processing and preservation methods.
3. Understanding about qualitative evaluation of foods concerning safety.
4. Understanding about packaging of processed plant and animal foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	1	1
	PO3	2	1	1	2
	PO4	1	1	2	2
	PO5	1	2	2	1

Note:

1. For the Generic elective (GE) to be chosen by Food Technology students, it is recommended that subjects like Biochemistry, Biology, Chemistry, Maths & statistics, Biostatistics, Physics be chosen as they are synergistic to the curriculum. However, students are free to pick up any of the Generic Elective Courses offered by other

departments.

2. If no other department offer generic elective*, student can choose any subject from following Generic Elective Courses which will be taught by subject faculty of respective department

GENERIC ELECTIVE

BSCGE-201-21 INTRODUCTION TO BIOLOGY

Total Marks: 100

L	T	P
4	0	0

Course objective: To make students understand the biological concepts related to evolution, life on earth, genetics, living systems.

UNIT I

Biological systems, evolution and biodiversity:

a. Introduction to concepts of biology: Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life

b. Evolutionary history of biological diversity : Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life

c. Classifying the diversity of life : Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

d. Darwinian view of life and origin of species: Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation

UNIT II

Biological systems, evolution and biodiversity:

e. Genetic approach to Biology: Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

UNIT III

Chemical context of living systems

a. Chemistry of life: The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

b. Water and life: The water molecule is polar; Properties of water; Ionization of water

UNIT IV

Chemical context of living systems

c. Carbon and life: Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds

d. Structure and function of biomolecules

Recommended Readings:

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

Course outcome

1. Understand the basic concepts, principles, and their applications to biological systems.
2. Understand the chemistry of carbon and analyze the potential for biology based on other elements.
3. Understanding about molecular basis of genetic information; genetic variation.
4. To understand structure and function of bio-molecules.

Formulation of Course Outcomes-Program Outcomes matrix

Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	3	1	2
	PO4	2	1	1	1
	PO5	2	2	1	1

BSCGE-202-21 INTRODUCTION TO BIOLOGY (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To understand the practical analysis associated with fundamentals of biology

Course Content

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Separation of A) amino acids B) chloroplast pigments by paper chromatography.
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To separate and quantify sugars by thin layer chromatography.
9. To raise the culture of *E. coli* and estimate the culture density by turbidity method. raw a growth curve from the available data.
10. Isolation of genomic DNA from *E.coli*.

Course outcome

1. Develop learning about working with microscope and preparation of normal, molar and standard solutions, buffers.
2. Develop learning about quantitative estimation of sugars, proteins.
3. Understanding about paper chromatography
4. Understanding about culturing and isolation concepts.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	1	1	1
	PO5	1	1	1	1

BSCGE-203-21 MATHEMATICS AND STATISTICS

Total Marks: 100

L	T	P
4	0	0

Course objective: To develop knowledge among students about statistical analysis of problems

UNIT I

Calculus: Successive differentiation, Mean Value Theorems and applications, Indeterminate forms, Introduction to anti-derivatives, Definite Integrals, Ordinary Differential equations.

UNIT II

Matrices: Eigen values, Cayley Hamilton Theorem, Applications of Matrices in solving system of equations.

UNIT III

Basic Statistics: Scope of statistics in food industries, errors, precision and threshold. Descriptive measures-Measures of central tendency, dispersion, skewness and kurtosis. Axiomatic approach to probability, Applications of Bayes Theorem, Random variables, Probability distributions, Mathematical expectation and variance, Binomial, Poisson and Normal distributions.

UNIT IV

Applied Statistics: Correlation and Regression, Sampling distributions, Standard error, Type I and Type II errors, Hypothesis testing- Large sample tests for means and proportions, Student's t- test, F-test, Chi square test, ANOVA (one way and two way).

Recommended Readings:

1. Introduction to Mathematics for Life Scientists, by E.Batschelet, Third edition, Springer International Edition.
2. Applied Calculus for the Managerial, Life and Social sciences by S.T.Tan, Fifth edition, Thomson Learning.
3. Biostatistics: a Foundation for Analysis in the Health Sciences, by Wayne W Daniel, Seventh edition, John Wiley and Sons
4. Biostatistical Analysis by J.H. Zar, Fourth edition, Pearson Education.

Course outcome

1. Understanding calculus.
2. Understanding about basic statistics and its scope in food industry.
3. Understanding matrices system and basic statistics
4. Understanding about applied statistics – t-test, F-test, Chi square test, ANOVA (one way & two way)

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	1	3	1
	PO3	2	1	1	2
	PO4	1	2	2	1
	PO5	1	1	1	1

SCGE-204-21 MATHEMATICS AND STATISTICS (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: To introduce and develop knowledge about practical aspect of statistical application in research

Course Content

Software labs using mathematical and statistical software such as Mathematical or Matlab, SPSS or Minitab

1. Exploring and sketching functions using derivatives.
2. Finding definite integrals.
3. Analysing the solutions of ordinary differential equations.
4. Presentation of Data by frequency tables, Graphs and Diagrams.
5. Computation of Measures of central tendency.
6. Computation of Measures of Dispersion.
7. Computation of raw and central moments, and measures of skewness and kurtosis.
8. Computation of correlation coefficient and Fitting of lines of Regression (Raw and Frequency data).
9. Analysing and interpreting a given data set by using hypothesis tests.
10. Performing one way and two way ANOVA.

Course outcome

1. Development of statistical reasoning, formulate a problem in statistical terms, perform exploratory analysis of data by graphical and other means, and carry out a variety of formal inference procedures.
2. Understanding about important theoretical results and understand how they can be applied to answer statistical questions.
3. Understanding about computation of central tendency, dispersion, measures of skewness and kurtosis.
4. Understanding about performing two way ANOVA

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	1	1	1
	PO5	1	2	2	2

BSCGE-205-21 BIOCHEMISTRY

Total Marks: 100	L	T	P
	4	0	0

Course objective: The Course objective of this course is to provide exposure to the students on cells, structural and functional units of living organisms, and their intricate organization

UNIT I

Biomolecules: Over view of amino acids, proteins and carbohydrates**.**
Lipids- Fatty acids, triacyl glycerols; glycerophospholipids, sphingolipids, sterols.
Nucleic acids- Nucleotides, Nitrogenous Bases- Purines and Pyrimidines; tautomers of bases, nucleotide derivatives, nucleotides as regulating molecules, different types of DNA and RNA

UNIT II

Enzymes Classification- Kinetics and Control: The Michaelis-Menten equation-derivation and physiological significance, the double reciprocal plots, kinetics of multisubstrate reactions, enzyme inhibition, turn over number of enzymes, *Regulatary enzymes*: General properties of allosteric enzymes, theories of allosteric regulation, regulation by covalent modification, kinetics, multienzyme complexes, negative and positive cooperativity, zymogens, isoenzymes, abzymes, ribozymes. *Mechanisms* of enzymes- catalysis, specificity, reactions rate, equilibrium, interaction between an enzymes and substrate, role of binding energy, acid base and covalent catalysis, lock and key & induced fit theories.

Coenzymes: Classifications (metabolite derived/vitamin derived) function of various types , structure of NAD^+, $NADP^+$, FAD & FMN,

Metabolism and Bioenergetics: Principles of bioenergetics-Standard free energy change, experimental measurement of ÎG, ATP and other reaction molecules, metabolic roles of ATP-Phosphoryl group transfer, nuleotidyl group transfer, biological oxidation- reduction reactions. General scheme of studying metabolic pathways, their local and global regulatory agents, energetics, disorders associated with the malfunctioning of pathways.

UNIT III

METABOLIC PATHWAYS
Carbohydrates metabolism: Glycolysis, alcoholic and lactic acid fermentation, pasteur effect, gluconeogenesis, cori-cycle, glucose-alanine cycle, futile cycle. TCA cycle, HMP shunt, glycogenolysis & glycogen synthesis.

Disorders associated with defects in carbohydrate metabolism- a brief account on fructose intolerance, lactose intolerance, lactic acidosis, disorders related to glycogen metabolism, genetic deficiency of Glucose-6-phosphate dehydrogenase, Galactosemia, pentosuria, Diabetes Mellitus (NIDDM and IDDM)

Lipid metabolism: Mobilization of triglycerides, metabolism of glycerol, -*oxidation* of saturated, mono- unsaturated and poly-unsaturated fatty acids, even and odd chain fatty acids. Ketone bodies *Biosynthesis* of fatty acids, fatty acid elongation and desaturation, biosynthesis of triacylglycerols.

Disorders associated with defects in Lipid metabolism: Refsum's disease, Gaucher's disease, Niemann Pick's disease, Tay Sach's disease

UNIT IV

Metabolism of amino acids: Assimilation of Ammonia: its incorporation in glutamate, glutamine and alanine as nitrogen carrier, regulation of glutamate dehydrogenase and glutamine synthetase, transamination reactions-role of pyridoxal phosphate, nitrogen excretion and *urea cycle*. *An overview of* degradation pathways of amino acids with detailed pathway

of phenylalanine and branched chain amino acids.

Disorders associated with defects in protein and amino acid metabolism: disorder associated with deficiency of Urea cycle enzymes, Phenylketonuria, Alcaptonuria, Maple syrup urine disease, tyrosinemia

Metabolism of Nucleotides: Brief outline of *Denovo* systhesis of purines and pyrimidines, salvage pathway, reduction of ribonucleotides to deoxyribonucleotides, degradation of purines and pyrimidines, nucleotide analogs as chemotherapeutic agents.

Disorders associated with defects in nucleotide metabolism- Gout, Lesch Nyhan Syndrome, SCID, Orotic aciduria.

Electron-transport chain (ETC) and oxidative phosphorylation: Constituents of ETC & their sequence (Complex I-IV) & location, inhibitors of ETC, chemiosmotic theory, ATP synthase complex- structure and function, dicarboxylic acid shuttle, glycerol phosphate shuttle, P:O ratio, regulation of oxidative phosphorylation.

Recommended Readings:

1. Lehningers Principles of Biochemistry by David L. Nelson and Michel M. Cox. Publisher: WH Freeman; Edition V..
2. Biochemistry by Lubert Stryer. Publisher:WH Freeman; Edition VI.
3. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. Publisher: McGraw Hill; Edition 28.
4. Biochemistry by Donald Voet and Judith Voet. Publisher: John Wiley and sons; Edition: II
5. Biochemistry by Mary K.Campbell & Shawn O.Farrell. Publisher: Cenage Learning. Edition

Course outcome

1. Understand the fundamental energetics of biochemical processes, chemical logic of metabolic pathways
2. Understanding about structure, functions and the mechanism of action of enzymes. Learning kinetics of enzyme catalyzed reactions and enzyme inhibitions and regulatory process. Exposure of wide application of enzymes.
3. Understanding about metabolic pathways – carbohydrate metabolism, lipid metabolism, metabolism of amino acids, and metabolism of nucleotides.
4. Understanding about the structure and properties of nucleic acids

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	2	2	1
	PO2	1	2	1	2
	PO3	1	1	1	2
	PO4	1	3	2	1
	PO5	1	3	1	1

BSCGE-206-21 BIOCHEMISTRY (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis

Course Content

1. Separation of biomolecules by electrophoresis.
2. Qualitative analysis of sugars.
3. To study the principle of spectrophotometer and verify Beer's law.
4. Quantitative estimation of DNA/RNA.
5. Quantitative estimation of protein using spectrophotometer.
6. To plot absorption spectrum of DNA and protein and find lmax.
7. To perform biochemical assay of an enzyme under optimal conditions.
8 To study the effect of pH/temperature/heavy metals/ on the activity of enzymes (any one factor).
9. To determine Km and Vmax of an enzyme.
10. Case studies related to metabolic disorders
Gierke's/Galactosemia, Phenylketonuria

Course outcome

1. Understand the principles of various fields of chemistry and biology (organic chemistry, analytical chemistry, biochemistry, genetics, metabolism, and molecular biology).
2. Understanding fundamental principles behind electrophoresis and apply them practically.
3. Quantitative determination of sugars
4. Understanding instrumentation and applications of spectroscopy, chromatography and sedimentation techniques.

Formulation of Course Outcomes-Program Outcomes matrix .

Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	1
	PO2	1	1	1	1
	PO3	1	1	1	1
	PO4	2	2	2	1
	PO5	1	1	1	1

BSCGE-207-21 CHEMISTRY
(CREDITS: THEORY – 4 PRACTICAL - 2)

Total Marks: 100

L	T	P
4	0	0

Course objective: Understand the principles of various fields of chemistry (organic, inorganic, physical, analytical, and biochemistry).

UNIT I

Periodic Table: Atomic, ionic and covalent radii, ionization energy, electronegativity and its scales, electron affinity, Lanthanide contraction, Inert pair effect.

Chemical bonds and molecules: General characteristics of ionic & covalent bonds, van der Waal forces of attraction (ion- dipole, dipole-dipole, dipole-induced dipole, and dispersion forces), polar covalent bond, hydrogen bond, effects of hydrogen bonding on physical properties, structure of water, metallic bond, lattice energy, Fajan's rule, bond length, bond angle, concept of resonance, dipole moment.

UNIT II

Organic reactions and their mechanisms: Types of reactions - addition, elimination, substitution & rearrangement. Mechanism of S_N1 and S_N2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group). Keto-enol tautomerism and its distinction from resonance. Structure and stability of reactive carbon species - carbonium ion, carbanion, free radical, carbenes.

Electronic effects in molecules (inductive, hyperconjugation and resonance effects); cleavage of covalent bonds – homolysis and heterolysis. Markownikoff and anti- markownikoff orientation; Electrophilic mono and disubstitution in benzene. Reaction mechanisms of Claisen condensation, Reimer-Tiemann reaction, Aldol condensation, Hoffman bromamide rearrangement, Cannizzaro reaction, Friedel Craft reaction, Pinacol-pinacolone rearrangement, Beckmann rearrangement.

UNIT III

Chemical equilibrium : Reversible reactions, law of mass action, equilibrium constant, ionic equilibrium, theory of indicators, factors influencing equilibrium states, relation between Kp & Kc, buffer solution, hydrolysis of salt, pH, Ksp, common ion effect and its applications in mixture analysis.

Electrochemistry : Standard electrode potential, electrochemical series, Nernst equation, Indicator & reference electrodes, pH & its measurements by glass electrode. Potentiometric determination of pH.

UNIT IV

Stereochemistry: Optical isomerism: Optical activity, polarimeter, specific rotation, enantiomerism, D & L designation, R & S sequence rules. Diastereoisomers, Isomers of tartaric acid, Geometrical Isomerism: Defination, nomenclature – E and Z

Polynuclear Hydrocarbons and Heterocyclic Compounds : Naphthalene, anthracene and phenanthrene (Structure, Huckle's rule, aromaticity, mechanism of substitution). Furan, pyrrole, thiophene, pyridine. (Synthesis, aromaticity, mechanism of substitution, acidity and basicity)

Recommended Readings:

1. J.D.Lee, Concise Inorganic Chemistry, ELBS.
2. J.E.Huheey, Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Publication.
3. Shriver and Atkins, Inorganic Chemistry, Oxford Publication.

4. Satya Prakash, G.D. Tuli, S.K. Basu and R.D. Madan, Advanced Inorganic Chemistry, S. Chand Publication.
5. Morrison and Boyd, Organic Chemistry, Prentice-Hall Publication.
6. I.L.Finar, Volume I, II, Organic Chemistry,ELBS.
7. V.K. Ahluwalia and R.K. Parashar, Organic Reaction Mechanisms, Second edition, Narosa Publication.
8. S.P. Bhutani, Selected topics in Organic Chemistry, Volume 1, Vishal Publication.
9. K.L. Kapoor, A textbook of Physical Chemistry Volume 1 and 3, Macmillan Publication.

Course outcome

1. Understanding about periodic table, chemical bonding.
2. Understanding about organic reactions and their mechanisms.
3. Understanding about the concept of stereochemistry, electrochemistry and chemical equilibrium
4. Understanding about the functional groups, their importance and functionality – carboxylic acids, alcohols, phenols, aldehydes & ketones, carbohydrates, amides, nitro compounds and primary amines

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	2	1	1
	PO3	1	1	2	2
	PO4	1	2	1	1
	PO5	1	1	1	1

BSCGE-208-21 CHEMISTRY (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: Students will gain an understanding of: chemical reactions and strategies to balance them; the relative quantities of reactants and products.

Course Content

1. To estimate iron(II) ions by titrating with potassium dichromate, using diphenylamine indicator.
2. To estimate copper(II) ions or potassium dichromate iodometrically by titrating with sodium thiosulphate.
3. To determine surface tension of a liquid using a stalagmometer.
4. To determine viscosity of a liquid using an Ostwald viscometer.
5. To analyze the following functional groups in the given organic compound: Carboxylic acids, alcohols, phenols, aldehydes & ketones, carbohydrates (monosaccharides), amides, nitro compounds and primary amines.

Recommended Readings:

1. Vogel's Textbook of Quantitative Chemical Analysis, G.F. Jeffry, J. Basset, J. Mendham and R.C. Denny, Longman Publication.
2. Comprehensive Practical Organic Chemistry, V.K. Ahluwalia and Sunita Dhingra, University Press.
3. Senior Practical Physical Chemistry, B.D. Khosla, V.C. Garg and Adarsh Gulati, R. Chand Publication

Course outcome

1. Understanding about basic chemistry lab skills.
2. Understanding about working equipments and apparatuses of chemistry lab.
3. Understand the principles of various fields of chemistry (organic, inorganic, physical, analytical, and biochemistry).
4. Understanding about the concept of chemical formulation preparations.

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	1	1	2
	PO4	1	2	1	1
	PO5	1	1	1	1

BSCGE-209-21 INTRODUCTION TO COMPUTERS

Total Marks: 100

L	T	P
4	0	0

Course objective: This course will develop knowledge regarding computer concepts, including fundamental functions and operations of the computer

UNIT I

FUNDAMENTAL OF COMPUTER : Introduction to computer, Applications of computer. Components of computer. Primary and Secondary storage. Number systems.
INTRODUCTION TO WINDOWS : Parts of window screen (Desktop, Window, Icons), Start menu, Taskbar, settings, application & document window, anatomy of a window (Title bar, minimize, maximize button, control box, scroll bars, scroll buttons, scroll boxes), Window explorer (expansion, collapsing of directory free, copying, moving, deleting files, folder, creating folders), About desktop icons (recycle bin, my computer, network neighbourhood, briefcase), folder, shortcut creation, setting of screen saver, color settings , wallpaper, changing window appearance.

UNIT-II

MS-WORD : Introduction to MS-word, Parts of window of word (Title bar, menu bar, status bar, ruler),Creation of new document, opening document, insert a document into another document. Page setup, margins, gutters, font properties, Alignment, page breaks, header, footer, deleting, moving replace, a filing text in document. Saving a document, spell checker, printing a document, creating a table, entering editing text in tables, changing format of table, height width of row or column Editing, deleting, rows, Columns in table . Borders, shading, Templates, Wizards Drawing objects, mail merge.

UNIT-III

MS-POWER POINT : Introduction, elements of Power Point Package, starting Power Point, Exploring Power Point menus, starting a new slide, Adding Titles, Text and Art, Moving text area and resizing text box starting a slide show, saving a presentation, printing slides, opening an existing presentation, Inserting and deleting slides in a presentation, changing text and correcting error, checking spelling, adding header and footer, closing a presentation, To quit from Power Point views, slide setup, setting up slide show, setting transistors and slide timings, Automatic slide show, Formatting and Enhancing text, Slide with graph.

UNIT IV

MS-Excel /spreadsheet: Basics of Spreadsheet/MS-excel, Parts of window of excel, Manipulation of cells; Formulas and Functions; Functions, and Formatting. Graphics and charts, Editing of Spread Sheet, printing of Spread Sheet.

Recommended Readings:

1. Goel, A. (2010). New Delhi: Dorling Kindersly (India) Pvt. Ltd.Computer Fundamentals.
2. Kapoor, V. K. (2006). Introduction to Computers and Information System. New Delhi: Sultan Chand & Sons.
3. ITL Education Solutions Limited, R. a. (2011). Fundamentals of Computers. Delhi: Dorling Kindersley (India) Pvt. Ltd.
4. Madan, S. (2012). Fundamentals of Computers and Information System. New Delhi: Scholar Tech Press.
5. Mohan, P. (2010). Fundamentals of Computers. Mumbai: Himalaya publishing House.
6. Murthy, C. S. (2010). Fundamentals of Computers. New Delhi: Himalaya Publishing House.
7. Suri, R. K., Rajput, N., & Verma, S. (2005). Introduction to Computers and Information System. Delhi: Sun India Publications.
8. Tiwari, H. N., & Jain, H. C. (2012). Fundamentals of Computer and Information System. New Delhi: International Book House Pvt. Ltd.
9. Vallabhan, S. V. (2009). Introduction to Computer Applications in Business. Delhi: Sultan Chand & Sons.

Course outcome

1. Understanding about use of Internet Web resources
2. Solve common business problems using appropriate Information Technology applications and systems.
3. Understanding about categories of programs, system software and applications.
4. Describe various types of networks network standards and communication software.
5. Understand MS-WORD, MS-POWER POINT, MS-EXCEL and its use.

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	1	1
	PO2	1	3	2	1
	PO3	1	1	1	2
	PO4	1	2	2	1
	PO5	1	1	1	1

BSCGE-210-21 INTRODUCTION TO COMPUTERS (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: The fundamental aim of this course is to teach students the basics of computing in terms of Windows, Word, MS-POWER POINT, MS-Excel.

Course Content

WINDOW:

1. Change the Background of the Desktop and also set the screen saver.
2. Create a Folder RAMAN and also create a Folder MOHAN with in the RAMAN folder.
3. Create a short cut of MS-Word on the desktop.
4. Delete some files from the MOHAN folder and also recall these files from the Recycle Bin. Empty the remaining recycle bin.
5. Copy some files from the C drive to floppy drive A using the Windows Explorer facility.

MS-WORD:

1. Create a document files, save it and print it.
2. Spell check the created document file.
3. Create a Table and sort the data within the table.
4. Mail Merge a inivitation to your friends.
5. Apply border to a particular paragraph and shade it 10% with Background yellow colour.

MS-POWER POINT:

1. Create a presentation, save it and print it.
2. Format a presentation with changing the fonts and size and selecting text style and colours.
3. Creat a graph ; add titles, axes and legends to a graph.
4. Add a Clipart picture to a chart.

MS-EXCEL:

1. Create a document files, save it and print it.
2. Spell check the created document file.
3. Create a Table and sort the data within the table.
4. Apply border to a particular paragraph and shade it 10% with Background yellow colour.
5. Use of formula

Course outcome

1. Understanding about components of applications software in the areas of word processing, spreadsheets, database management, presentation graphics, data communications, and Internet
2. Use operating system software in the Windows environment
3. Use software packages in word processing, spreadsheets, database management, and graphics
4. Understand about Web browsers, search engines and e-mail.

Formulation of Course Outcomes-Program Outcomes matrix.

Program Outcome (PO)	Course Outcome (CO)			
	CO1	CO2	CO3	CO4
PO1	1	1	2	2
PO2	1	1	1	1
PO3	1	1	1	2
PO4	1	1	1	1
PO5	1	1	1	1

Semester Fifth

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSFT311-21	Food Engineering	4	0	0	40	60	100	4
BSFT312-21	Oil & Fat Processing Technology	4	0	0	40	60	100	4
BSFT313-21	Lab- Food Engineering	0	0	4	30	20	50	2
BSFT314-21	Lab - Oil & Fat Processing Technology	0	0	4	30	20	50	2
XXXXXX	DSE -1 Theory	4	0	0	40	60	100	4
XXXXXX	DSE -1 Lab	0	0	4	30	20	50	2
XXXXXX	DSE -2 Theory	4	0	0	40	60	100	4
XXXXXX	DSE -2 Lab	0	0	4	30	20	50	2
BSFT319-21	In Plant Training Seminar	0	0	6	0	25	25	1
BMPD502-21	Mentoring and Professional Development	0	0	1	*25	--	25	1
	Total	**16**	**0**	**17**	**305**	**320**	**625**	**26**

Note: * Mentoring and Professional Development course will have internal evaluation only

Discipline Specific Elective (DSE)

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSCDSE-105-21	DSE-1 Bakery Technology (Theory)	4	0	0	40	60	100	4
BSCDSE-106-21	DSE-1 Bakery Technology (Lab)	0	0	4	30	20	50	2
BSCDSE-107-21	DSE-2 Food Packaging (Theory)	4	0	0	40	60	100	4
BSCDSE-108-21	DSE-2 Food Packaging (Lab)	0	0	4	30	20	50	2

Semester Sixth

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSFT321-21	Dairy Technology	4	0	0	40	60	100	4
BSFT322-21	Food Quality and Sensory Evaluation	4	0	0	40	60	100	4
BSFT323-21	Lab- Dairy Technology	0	0	4	30	20	50	2
BSFT324-21	Lab- Food Quality and Sensory Evaluation	0	0	4	30	20	50	2
XXXXXX	DSE -3 Theory	4	0	0	40	60	100	4
XXXXXX	DSE -3 Lab	0	0	4	30	20	50	2
XXXXXX	DSE -4 Theory	4	0	0	40	60	100	4
XXXXXX	DSE -4 Lab	0	0	4	30	20	50	2
BMPD602-21	Mentoring and Professional Development	0	0	1	*25	--	25	1
	Total	**16**	**0**	**17**	**305**	**320**	**625**	**25**

Note: * Mentoring and Professional Development course will have internal evaluation only

Discipline Specific Elective (DSE)

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
BSCDSE-109-21	DSE -3 Nutraceuticals and Functional Foods (Theory)	4	0	0	40	60	100	4
BSCDSE-110-21	DSE -3 Nutraceuticals and Functional Foods (Lab)	0	0	4	30	20	50	2
BSCDSE-111-21	DSE -4 Food Plant Sanitation (Theory)	4	0	0	40	60	100	4
BSCDSE-112-21	DSE -4 Food Plant Sanitation (Lab)	0	0	4	30	20	50	2

SEMESTER

FIFTH

BSFT311-21: FOOD ENGINEERING

Total Marks: 100

L	T	P
4	0	0

UNIT I

Introduction: Concept of Unit operation, Units and dimensions, Unit conversions, dimensional analysis, Mass and Energy Balance. Related numerical

Design of food plant: Important considerations for designing of food plants, Types of layout

Grinding and mixing: Principle and equipments used in food industry

UNIT II

Fluid Flow in food Processing: Liquid Transport systems, Properties of Liquids, 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 numericals

Refrigeration and Freezing: 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, Numericals based on VCR system, Freon 12 and R-717, superheating and sub cooling, Freezing time calculation using Plank's Equation, Frozen food storage
Related basic numericals

UNIT III

Heat and Mass Transfer: Systems for heating and cooling food products, Thermal Properties of Food, Modes of heat transfer, Application of steady state heat transfer- estimation of conductive heat transfer cofficient, convective heat transfer coefficient, overall heat transfer coefficient and, design of tubular heat exchanger. Related basic numericals, Fick's Law of Diffusion, Membrane separation systems-Electrodialysis system , Reverse Osmosis, Membrane System, and Ultrafiltration Membrane System, Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices.

UNIT IV

Psychrometrics: Properties of Dry Air, Properties of Water Vapour, Properties of air Vapour mixture, Psychrometric Chart, Related basic numericals

Steam, Evaporation and Dehydration: Generation of steam, Construction and functions of fire tube and water tube boilers, Thermodynamics of Phase change, Steam tables, Boiling point elevation Types of evaporations, Design of single effect evaporators, Basic Drying Process, Moisture content on wet basis and dry basis, Dehydration systems, Dehydration system Design. Related basic numericals

Recommended Readings

1) Rao DG. 2010. Fundamentals of food engineering. PHI learning private ltd.

2) Singh RP and Heldman DR.1993, 2003, 2009. Introduction to food engineering. Academic press 2nd, 3rd and 4th edition.

3) Rao C G 2006 Essentials of food process engineering. B S publications

4) Fellow P. 1988. Food processing technology

BSFT312-21: OIL AND FAT PROCESSING TECHNOLOGY

Total Marks: 100

L	T	P
4	0	0

UNIT I

Sources; chemical composition; physical and chemical characteristics; functional and nutritional importance of dietary oils and fats. Post-harvest handling storage and processing of oilseeds for directs use and consumption.

UNIT II

Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cottonseed, rice bran, maize germ, etc.

UNIT III

Refining: Clarification, degumming, neutralization (alkali refining), bleaching, deodorization techniques / processes. Blending of oils.

Processing of refined oils: Hydrogenation, fractionation, winterzation, inter-esterification etc. for obtaining tailor-made fats and oils.

UNIT IV

Production of butter oil, lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Speciality fats and designer lipids for nutrition and dietetics, especially by biotechnology.

Recommended Readings

1. Bailey's Industrial Oil & Fat Products, 4th ed.John Wiley & Sons.
2. The Industrial Chemistry of Facts & Waxes 3rd. by Balliere,Tindall & Cox.
3. Handling & Storage of Oiseeds,Oils,Fats & Meal by Paterson, HBW.
4. Modern Technology in the Oils & Fats industry by S.C. Singhal,OTA (I).

BSFT313-21: FOOD ENGINEERING (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course Content

1. Plant layout design
2. Determination of drying characteristics
3. Determination of viscosity of Newtonian and non Newtonian fluids
4. Study of effect of temperature on viscosity
5. Screen analysis of food sample
6. Study of evaporation process
7. Freezing time calculation
8. Psychrometrics- use and application.

BSFT314-21: OIL AND FAT PROCESSING TECHNOLOGY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course Content

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

BMPD502-21 MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	1	0	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

SEMESTER

SIXTH

BSFT321-21: DAIRY TECHNOLOGY

Total Marks: 100

L	T	P
4	0	0

UNIT I

Dairy industry in India: scope, strengths and opportunities for dairy industry.

Definition, composition and nutritive value of milk, Environmental and biological factors affecting composition of milk. Physicochemical properties of milk. Milk lipids: chemical properties, structure, fat destabilization, functional properties. Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring auto- oxidation, prevention, measurement of auto-oxidation. Milk proteins: types, protein precipitation (casein micellar structure and its aggregation). Milk enzymes- catalase, alkaline phosphatase, lipases and proteases, enzymatic and acid coagulation of milk

UNIT II

Market milk industry and milk products: Systems of collection of milk Reception, Platform testing; Brief introduction to Standard milk, Toned milk, Double toned milk, Flavoured milk, Vitamin enriched milk, Reconstituted milk and recombined milk. Legal and ISI standards of milk. Adulteration of milk and its detection. Common preservative used in milk and their detection. Clean milk production. Various stages of processing, Filtration, Clarification, Storage and processing of fluid milk: pasteurization, sterilization, homogenization, UHT processing and aseptic packaging. Standardization of milk**.**

Cream: Different types of cream with their respective fat content, composition of cream, production methods. Factors affecting the richness of cream produced by cream separator. Efficiency of cream separator. Ripening of cream for butter making: natural ripening, ripening with the use of starter cultures. Objects of cream ripening. Various changes during the ripening of cream.

UNIT III

Butter : Types of butter, composition. Preparation of butter. Factors affecting the churnability of cream. Churning theories.Grading of butter, Defects of butter their possible causes and their remedies. Standards of butter and shelf life.

Cheese: Classification of cheese. Quality of milk for cheese.Preparation methods of cheddar cheese.

Indigenous milk products - dahi, ghee, channa, paneer, shrikhand etc. Utilization of milk industry by-products- importance/need and food applications.

UNIT IV

Ice Cream: Different types of ice creams and their composition. Ingredients used and their role in processing. Manufacturing process. Defects of ice cream, their causes and remedies.

Condensed and evaporated milk: Definition, composition & standards. Condensing operations.

Dried milk products: Introduction, objects of production, standards and composition. Preparation of dried milk and milk powder by roller and spray drying methods. Packaging and storage. Malted milk powders and infant milk food.

Recommended readings:

1. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford. 2007.

2 Webb and Johnson, Fundamentals of Dairy Chemistry, 3rd ed., CBS Publishers, New Delhi 1988

3 Byron, H. W., Arnold, H. J. & John, A. A. (1987). *Fundamentals of Dairy Chemistry* (2nd ed.): CBS, Delhi.

4 Atherton, H. V. & Newlander, J. A. (1987). *Chemistry and Testing of Dairy Products* (4th ed.): CBS, New Delhi.

5 Wong, N. P. (1988). Fundamentals of Dairy Chemistry (3rd ed.): VNR, New York.

6 Cheke, V. & Sheepard, A. (1997). Cheese and Buller: Allied, Bikaner.

BSFT322-21: FOOD QUALITY AND SENSORY EVALUATION

Total Marks: 100	L	T	P
	4	0	0

UNIT I

Introduction to quality attributes of food: Appearance, flavor, textural factors and additional quality factors.

UNIT II

Gustation: Introduction and importance of gustation, 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 measurement- Electronic Tongue; Taste abnormalities

UNIT III

Olfaction: Introduction, definition and importance of odour and flavor; Anatomy of nose, physiology of odour perception; Mechanism of odour perception, Theories of odour classification, chemical specificity of odour. Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc. Olfactory abnormalities

UNIT IV

Colour: Introduction and importance of colour; Dimensions of colour and attributes of colour; gloss etc.; Perception of colour.; Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, etc.; Colour abnormalities

Texture: Introduction, definition and importance of texture; Phases of oral processing; Texture perception, receptors involved in texture perception; Rheology of foods; Texture classification; Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation. Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products

Recommended Readings

1. Rao E. S. (2013). Food Quality Evaluation. Variety Books.
2. Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.
3. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.
4. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.
5. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.

BSFT323-21: DAIRY TECHNOLOGY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course Content

1. Sampling of milk and milk products,
2. Platform tests of milk:
    a. Organoleptic test,
    b. Sediment test,
    c. COB test,
    d. Alcohol test,
    e. Alcohol-Alizarin test,
    f. Titratable acidity and
    g. pH milk.
3. To estimate milk protein by Folin method.
4. To estimate milk fat by Gerber method
5. Determination of specific gravity of milk,
6. Total solids and solid-not-fat using lactometer,
7. Detection of milk adulterant-
    a. Added water,
    b. Starch,
    c. Cane sugar,
    d. Neutralizers and
    e. Preservatives (formalin and hydrogen peroxide),
    f. Synthetic milk (urea test, detergent test, common salt),
8. To prepare casein and calculate its yield.
9. Alkaline phosphatase test to determine adequacy of pasteurization.
10. Preparation of flavoured milk/. Pasteurization of milk
11. Peroxide value, Iodine value of ghee,
12. Acid value of ghee,
13. Saponification value of ghee,
14. Development of ice cream

BSFT324-21: FOOD QUALITY AND SENSORY EVALUATION (LAB)

Total Marks: 50

L	T	P
0	0	4

Course Content

1. Training of sensory panel.
2. To perform sensitivity tests for four basic tastes
3. To perform analytical and affective tests of sensory evaluation.
4. Recognition tests for various food flavors.
5. Sensory evaluation of milk and milk products.
6. Flavor defects in milk
7. Extraction of pigments from various fruits and vegetables and study the effect of temperature and pH
8. Texture evaluation of various food samples- cookies/ biscuits/ snack foods
9. Textural measurement of various food products using Texture Analyzer
10. Measurement of colour by using Tintometer/ Hunter Colour Lab etc.

BMPD602-21 MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	1	0	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

3. Sports/NSS/NCC
4. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

Choice Based Credit Based System

Scheme & Syllabus of

Master of Technology- Food Technology/

(M. Tech of Food Technology)

Batch 2018
(Minor revision on 29/07/2019)

By

Board of Study (Food Science and Engineering)
(Main Campus)

Department of Food Science and Technology
IK Gujral Punjab Technical University

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

Master of Technology in Food Technology (M Tech of Food Technology)/
It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)

Eligibility for Admission: B. Tech./ B.E. (Food Engineering/ Food Technology/ Food Engineering & Technology/ Food Process Engineering/ Food Process Technology/ Dairy Technology/ Dairy Engineering/ Food Biotechnology/ Agri. Process Engineering/ Agri. Engineering/Biotechnology) or any equivalent degree with at least 55% marks.

OR

M.Sc. (Food Science/ Food Technology/ Food Science and Technology/ Food Processing and Technology/ Biotechnology) or any equivalent degree with at least 55% marks.

Courses & Examination Scheme:

Program Core (PC)	Program Elective (PE)	Open Elective (OE)	Research	Total Credits
45	10	04	26	85

Semester First

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTFT-511-18	Advances in Food Engineering	PC	4	0	0	40	60	100	4
MTFT-512-18	Advances in Food Analysis	PC	4	0	0	40	60	100	4
MTFT-513-18	Food Safety and Quality Assurance	PC	4	0	0	40	60	100	4
MTFT-514-18	Advances in Post-harvest Technology of Fruits and Vegetable	PC	4	0	0	40	60	100	4
MTFT-515-18	Lab-I (Advances in Food Analysis)	PC	0	0	4	30	20	50	2
MTFT-516-18	Lab-II (Food Safety and Quality Assurance)	PC	0	0	4	30	20	50	2
MTFT-517-18	Lab-III (Advances in Post-harvest Technology of Fruits and Vegetable)	PC	0	0	4	30	20	50	2
	Total		**16**	**0**	**12**	**250**	**300**	**550**	**22**

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Semester Second

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTFT-521-18	Advanced Food Processing Technology	PC	4	0	0	40	60	100	4
MTFT-522-18	Advances in Cereal Science and Technology	PC	4	0	0	40	60	100	4
MTFT-523-18	Novel Food Packaging	PC	4	0	0	40	60	100	4
MTFT-524-18	Lab-IV (Cereal Science & Technology)	PC	0	0	4	30	20	50	2
MTFT-525-18	Lab-V (Novel Food Packaging)	PC	0	0	4	30	20	50	2
MTFT-526-18-528-18	Program Elective-1 (Theory)	PE	4	0	0	40	60	100	4
MTFT-529-18-531-18	Program Elective-1 (Lab.VI)	PE	0	0	4	30	20	50	2
	Total		**16**	**0**	**12**	**250**	**300**	**550**	**22**

Programme Elective-I *

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTFT-526-18	Food Additives and Contaminants	PE	4	0	0	40	60	100	4
MTFT-527-18	Nutraceuticals and Functional Foods	PE	4	0	0	40	60	100	4
MTFT-528-18	Technology of Frozen Foods	PE	4	0	0	40	60	100	4
MTFT-529-18	Lab-VI (Food Additives and Contaminants)	PE	0	0	4	30	20	50	2
MTFT-530-18	Lab-VI (Nutraceuticals and Functional Food)	PE	0	0	4	30	20	50	2
MTFT-531-18	Lab-VI (Frozen Food Technology)	PE	0	0	4	30	20	50	2

Note: * Select any one subject from Elective-I. The elective subject for theory & practical will be same.

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Semester Third

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTFT-611-18	Milk and Milk Products Technology	PC	4	0	0	40	60	100	4
MTFT-612-18	Lab-VII (Milk and Milk Products)	PC	0	0	4	30	20	50	2
MTFT-613-18	Seminar	PC	0	0	2	30	20	50	1
MTFT-614-18	Open elective[#]	OE	4	0	0	40	60	100	4
MTFT-615-18-617-18	Program Elective-II	PE	4	0	0	40	60	100	4
MTFT-618-18	Dissertation-I	RP	0	0	10	60	40	100	10
	Total		**12**	**0**	**16**	**240**	**260**	**500**	**25**

 # open elective: The student is required to register for one "Open Elective" paper (in Semester III) of his/her choice from any department other than the parent department

Programme Elective-II **

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTFT-615-18	Food Rheology and Texture	PE	4	0	0	40	60	100	4
MTFT-616-18	Bio Process Engineering	PE	4	0	0	40	60	100	4
MTFT-617-18	Advances in Meat, Fish, Poultry and Egg processing	PE	4	0	0	40	60	100	4

Note: ** Select any one subject from Elective-II.

Semester Fourth

Corse Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MTFT-621-18	Dissertation-II	RP	0	0	32	60	40	100	16
	Total		**0**	**0**	**32**	**60**	**40**	**100**	**16**

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

Important Notes: -

1. The credit requirement for the M. Tech (Food Technology) degree is 85 credits inclusive of the 10 elective course credits.
2. The department will offer the following open elective courses for the students of other Engineering departments:
   i. Food Safety and Quality Assurance
   ii. Advances in Food Analysis
3. Theory courses will be of 04 hours and practical will be of 04 hours duration per week. For all lecture courses, one credit per lecture/week/semester will generally be adopted. One laboratory hour per week per semester will be assigned half credit.
4. No elective course will be run unless the number of students registered for the elective course is five or more.
5. Each theory paper examination will be of 3 hours duration and practical examination will be of 4 hours duration.
6. A student is required to undertake a Research Project of 16 credits on a topic approved by the supervisor and the Departmental Research Committee (DRC). The student is required to prepare his/her research project synopsis and should make a presentation to the DRC before the commencement of the final examination of third semester.
7. The research project shall be evaluated by the external examiner at the end of the Semester IV.
8. The student is required to register for one "Open Elective" paper (in Semester III) of his/her choice from any department other than the parent department.
9. A Supervisor will be allotted by the Chairperson for every student in the beginning of third semester.

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

Program outcomes

1. Ability to apply principles of food engineering in industry.
2. Understand, identify and analyze a problem related to food industry and ability to find an appropriate solution for the same.
3. Design, implement and evaluate a research based project to meet demands of the society.
4. Use appropriate techniques, skills, and modern tools in the food industry and in academic profession.
5. Understanding of professional, ethical, legal, security and social issues and responsibilities for entrepreneurship skills.
6. Ability to function effectively as an individual and in a group.

SEMESTER

THIRD

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

MTFT-611-18: TECHNOLOGY OF MILK AND MILK PRODUCTS

Total Marks: 100	L	T	P
	4	0	0

Objective:

1. To illustrate the technologies of processing of milk and milk products.
2. To describe the different physico-thermal properties and their applications.
3. To elucidate the thermal processing of milk and quality changes therein.
4. To explain thehygiene and sanitation practices in milk plant.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand the processes related to storage, processing and distribution of milk and milk Products.
2. Perceive the different properties of milk and milk products.
3. Apprehend the thermal processing of milk.
4. Grasp the technology of fat rich dairy products.
5. Comprehend the technology of condensed milk, dried milk, cheese, yoghurt and indigenous products will be understood.
6. Have knowledge regarding hygiene and sanitation practices in the milk and milk products industry.

Course Content:

UNIT-I

Technology of Market Milk:Dairy Industry in India: present status and scope; Milk: definition, composition and nutritive value; grading of milk; factors affecting composition of milk; physico-chemical properties of milk; FSSAI standards and legislations for market milk. Liquid milk processing: filtration/clarification; bactofugation; standardization; homogenization; pasteurization (LTLT, HTST); sterilization; UHT processing; aseptic packaging; storage and distribution. Technology of special milks: Technology of sterilized/ flavored milk, acidophilus milk, bulgarian milk, kumis, kefir; reconstituted & recombined milk, toned, double toned milk.

UNIT-II

Technology of fat rich dairy products: Cream: definition and legal standards, consumer cream products, standardization & production of cream, processing of cream (neutralization & pasteurization), butter: definition, butter-making process, overrun, yield, theories of churning, quality of butter, fat losses in cream & butter, defects in cream & butter. Ice-cream: definition, classification and composition of ice-cream, technological aspects of ice cream preparation, packaging, hardening, storage and shipping of ice cream.

UNIT-III

Technology of condensed and dried milk: Definition and legal standards for evaporated and condensed milks, methods of manufacture and physico-chemical properties of evaporated and condensed milk, concept of heat stability & its control, defects in condensed and evaporated milks, Quality of raw milk for dried milks, definition and legal standards for dried milks, milk drying system (film, roller, drum, spray, foam spray drying), method of manufacture of dried milks (WMP & SMP), defects in dried milk,Technology of yoghurt and cheese: Yoghurt - Definition and technology of yoghurt manufacturing, technology of different varieties of cheese manufacturing (cheddar &mozarella), changes during ripening of cheese, yield of cheese; manufacture of processed cheese, defects in cheese, accelerated ripening of cheese.

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UNIT-IV

Technology of indigenous dairy products: Introduction to traditional dairy products, khoa, channa, paneer, dahi, shrikhand, ghee, khoa and channa based sweets, miscellaneous traditional dairy foods, Dairy industry by-products and sanitation: By-products: introduction, definition, composition, Importance and food applications,whey protein concentrates& isolates,Dairy plant sanitation: hygiene in dairy industry, different types of cleansing/sanitizing agents and their applications, cleaning systems in dairy industry.

Recommended Readings:

1. Winton, A. L. and Winton, K. B. (2000). *Milk and Milk Products*: Agrobios, India.
2. Kutty, C. I. and Khamer, S. (2004). *Milk Production and Processing*: Daya, Delhi.
3. Fox, P. F. and McSweeney, P. L. H. (1998). *Dairy Chemistry and Biochemistry*: Kluwer Academic, New York.
4. Kurmann, J. A., Rasic, J. L. and Kroger, M. (1992). *Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey and Related Products*: CBS Publications, New Delhi.
5. Davis, J. G. (1994). *Milk Testing: The Laboratory Control of Milk*: Agro Botanical, Bikaner.

Mapping of course "Technology of Milk and Milk Products- MTFT-611-18"outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
Course Outcome (CO)	**CO 1**	**2**	**2**	**2**	**3**	**2**	**3**
	CO 2	**2**	**2**	**2**	**3**	**3**	**2**
	CO 3	**2**	**2**	**1**	**3**	**1**	**3**
	CO 4	**3**	**2**	**2**	**3**	**2**	**3**
	CO 5	**3**	**2**	**2**	**3**	**1**	**3**
	CO 6	**1**	**2**	**2**	**3**	**2**	**3**

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MTFT–612-18: Lab-VII (MILK AND MILK PRODUCTS QUALITY)

Total Marks: 50

L	T	P
0	0	4

Objective:

1. To exemplify the quality of milk and milk products.
2. To depict the detection of adulterants in milk.
3. To demonstrate the manufacturing various dairy products.
4. To illustrate the quality of dairy products.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand different methods of milk quality analysis.
2. Grasp the detection methods of adulterants in milk.
3. Apprehend the manufacturing of different dairy products.
4. Perceive the quality analysis of dairy products.

Course Content:

Analysis of milk: total solids, fat, SNF, protein, lactose, acidity, ash, total bacterial count, analysis of adulteration of milk (sugar, carbohydrate, urea, neutralizer, water), turbidity test for sterilized milk, preparation of sterilized flavoured milk, Cream preparation, preparation of butter from sour cream, salt analysis in butter, overrun in butter, yield of butter, preparation of ghee from cream/ butter, FFA value of ghee, preparation of ice-cream, overrun of ice cream (by weight/by volume), preparation of cheddar/gouda/mozzarella cheese, moisture of milk powder, bulk/true density of milk powder, solubility of milk powder, preparation of prebiotic yoghurt/ dahi, compositional analysis of traditional dairy products, manufacturing of sodium caseinate/calcium caseinate.

Mapping of course "Lab-VII (Milk and Milk Products Quality)- MTFT–612-18" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
Course Outcome (CO)	**CO 1**	**1**	**2**	**2**	**3**	**2**	**3**
	CO 2	**2**	**2**	**2**	**3**	**2**	**2**
	CO 3	**1**	**2**	**1**	**3**	**2**	**2**
	CO 4	**2**	**2**	**2**	**3**	**2**	**2**

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MTFT-618-18: Dissertation-I

L	T	P
0	0	10

The student is required to prepare his/her Presentation I, Presentation II and Report as per notification no. IKGPTU/Reg/NF/157 dated 04/04/2019 and should make a presentation to the DRC and external expert at the end of third semester.

ELECTIVE-II

IK Gujral Punjab Technical University
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MTFT-615-18: FOOD RHEOLOGY AND TEXTURE

Total Marks: 100	L	T	P
	4	0	0

Objective:

1. To understand the concepts of food rheology and food texture
2. To depict rheological properties of foods and measuring methods.

Course Outcome: After the completion of the course, the students will be able to:

1. Comprehend various rheological and textural properties of solid and liquid foods.
2. Apprehend different models and tests related to food rheology.
3. Grasp knowledge regarding various instruments used in determination of food rheology.

Course Content:

UNIT-I

Food rheology concept, scope of food rheology, texture of foods – type of stress, types of strain, types of viscosity, modulus (young, shear, bulk), poisson's ratio, definition and importance of texture, texture-related concepts.

UNIT-II

Determination of rheological properties and measuring methods: destructive and non-destructive measurements, creep recovery and stress relaxation, dynamic mechanical tests, Modeling food texture: introduction, factor affecting texture, models to predict texture.

UNIT-III

Rheological properties of fluid food: viscosity, factors affecting viscosity, flow of material- Newton's law of viscosity, viscous fluids (Newtonian fluids, non-Newtonian fluids), plastic fluids (Bingham plastic, non-Bingham plastic fluids), fluid behavior in steady- shear flow: time dependent and time independent material function, viscosity measurement- capillary flow viscometers, orifice type viscometers, falling ball viscometers, rotational viscometers- concentric cylinder (coaxial rotational) viscometers, cone and plate viscometers, parallel plate viscometers, single-spindle viscometers (brookfield viscometer).

UNIT-IV

Rheological properties of solid food: deformation of material, viscoelastic behavior, Failure and glass transition in solid foods: failure in solid foods, glass transition of solids foods (measurement, factors affecting, importance), Texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis, dough testing instruments- farinograph and mixograph, extensograph and alveograph, amylograph.

Recommended readings:

1. Rao, M. A., Rizvi, S. S. H. and Datta A. K. 2005. *Engineering Properties of Foods*: CRC Press.
2. Heldman, D. R. (2007). *Food Process Engineering*:AVI Publications.
3. Faridi, H. and Faubion, J. M. (1997). *Dough Rheology and Baked Products*: CBS Publications, New Delhi.

4. Rao, M. A. (2007). *Rheology of Fluid and Semisolid Foods: Principles and Applications* (2 ed.): Springer, USA.

Mapping of course "Food Rheology and Texture- MTFT-615-18" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	1	2	3	1	2
	CO 2	3	1	2	2	1	2
	CO 3	2	2	1	2	1	2

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MTFT-616-18: BIOPROCESS ENGINEERING

Total Marks: 100	L	T	P
	4	0	0

Objective:

1. To acquaint the students with recent concepts of Bioprocess Engineering.
2. To illustrate the functioning of various devices involved in formation and recovery of bio-processed products.

Course Outcome: After the completion of the course, the students will be able to:

1. Aware of the status of bio-processing in food industry.
2. Comprehend the fermentation technology involving design and processing.
3. Perceive knowledge regarding instrumentation involved in production of bio-processed products.
4. Apprehend about the recovery of bio-processed products.

Course Content:

UNIT-I

Introduction to bioprocessing, historical developments, bioenergetics, enzyme kinetics- Micaelismenton model, effect of temperature on reaction rate, microbial growth kinetics- batch culture, continuous culture, fed batch culture and application of fed batch culture, Sterilization and sanitation: thermal death kinetics, medium sterilization (batch and continuous design), sterilization of fermenter, feed and wastes; filter sterilization of media, air and exhaust air; theory of depth filters, isolation, preservation (storage on reduced temp, storage under liquid nitrogen, storage on agar slopes, storage in dehydrated form) and improvement of industrially important micro-organisms.

UNIT-II

Fermenter design- basic functions of fermenters, types of fermenter, construction material, pipes and tubes, valves and steam traps, agitator and impeller, stirrer and bearing (seals and drives), sparger, baffles, achievement and maintenance of aseptic conditions (sterilization of air, exhaust gas and fermenter), sampling port, controlling devices.

UNIT-III

Product recovery- foam separation, precipitation, filtration (batch, continuous, cross flow filtration), filter aids, filteration equipment, filteration theory, centrifugation, centrifuge equipment, centrifugation theory, liquid- liquid extraction– solvent recovery, two phase aqueous extraction, supercritical fluid extraction, chromatography, (adsorption chromatography, gel permeation, ion exchange chromatography, HPLC, RPC, continuous chromatography), membrane processes (ultrafilteraiton, reverse osmosis, liquid membranes), drying, crystallization, whole broth processing.

UNIT-IV

Bioprocess instrumentation- Offline analytical methods, physical, chemical and biosensors, online sensors.

Recommended readings:

1. Doran, P. M. (1995). *Bioprocess Engineering Principles*: Academic press, New Delhi.
2. Shuler, M. L. (2002). *Bioprocess Engineering Basic Concepts* (2 ed.): PHI, New Delhi.

3. Sablani, S. S., Rahman, M. S., Datta, A. K. and Mujumdar, A. S. (2007). *Handbook of Food and Bioprocess Modeling Techniques*: CRC Publications, New York.

Mapping of course "Bioprocess Engineering- MTFT-616-18" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
Course Outcome (CO)	**CO 1**	**2**	**2**	**2**	**2**	**2**	**1**
	CO 2	**2**	**2**	**1**	**3**	**1**	**2**
	CO 3	**2**	**2**	**2**	**2**	**1**	**2**
	CO 4	**1**	**2**	**2**	**3**	**1**	**2**

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

MTFT-617-18: ADVANCED MEAT, FISH, POULTRY AND EGG TECHNOLOGY

Total Marks: 100	L	T	P
	4	0	0

Objective:

1. To understand the importance of livestock, egg and poultry industry.
2. To describestructure, composition and nutritional quality of animal products.
3. To comprehend the various post-mortem changes related to muscle and various other tissues.
4. To illustrate the processing technology of meat, poultry, fish and eggs.
5. To explain value addition and packaging of meat, fish and poultry products.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand the technology for raw material characteristics, handling, processing, and preservation.
2. Grasp by-product utilization of meat, poultry, fish and egg products.
3. Apprehend the hygiene, sanitation and mechanized practices of meat, fish, poultry and egg industry.
4. Comprehend the food standards in relation to these food commodities.
5. Perceive the knowledge regarding transportation and storage practices.
6. Prepare various value added products.

Course Content:

UNIT-I

Production, Processing and consumption trends, Prospects of meat industry, Meat spoilage, Endogenous and exogenous infections, Hygiene and sanitation, Meat composition from different sources, Post-mortem muscle chemistry and composition, Intramuscular fat, Rigor mortis, The conversion of muscle into meat: Animals' stunning methods, ante-mortem and post-mortem examination, Design of handling facilities: Slaughtering and dressing, Consequences of circulatory failure, Proteolytic and other chemical changes, Operational factors affecting meat quality, Effects of processing on meat tenderization, Chilling, freezing and preservation, prepared meat products, intermediate moisture and dried meat products, The eating quality of meat: color, flavors and retention, water holding capacity, juiciness, texture and taste, meat eating and health, Inedible by-products.

UNIT-II

Quality characteristics of poultry products, Lay-out and design of poultry processing plants, Plant sanitation, Poultry meat processing operations and equipment for de-feathering, bleeding, scalding etc., Poultry meat products, Refrigerated storage of poultry meat, by-products

UNIT-III

Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage, eating quality of eggs, Inspection and grading, preservation and safe handling.

UNIT-IV

Commercially important marine products from India, Product export and its sustenance, Processing operations, Basic biochemistry, Preservation of postharvest fish freshness, Transportation in refrigerated vehicles, Deodorization of transport systems, Design of refrigerated and insulated trucks,

Grading and preservation of shell fish, pickling and preparation of fish protein concentrate, fish oil and other by-products

Recommended Readings:

1. Lawrie, R. A. (1998). *Lawrie's Meat Science* (6 ed.): Woodhead Publications, Cambridge.
2. Alan, H. V. and Jane, P. S. (1995). *Meat and Meat Products: Technology, Chemistry and Microbiology*: Champan& Hill, London.
3. Carmen, R. O. and George, J. M. (1997). *Poultry Meat and Egg Production*: CBS Publications, New Delhi.
4. Winton, A. L. and Barberwinton, K. (1999). *Fish and Fish Products*: Agrobios, Bikaner.
5. Winton, A. L. and Winton, K. B. (1993). *The Structure and Composition of Animal Product*: Agro Botanical, Bikaner.

Mapping of course "Advanced Meat, Fish, Poultry and Egg Technology- MTFT-617-18"outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
Course Outcome (CO)	**CO 1**	**2**	**2**	**2**	**3**	**1**	**2**
	CO 2	**2**	**1**	**2**	**3**	**1**	**2**
	CO 3	**3**	**2**	**2**	**2**	**2**	**2**
	CO 4	**2**	**2**	**2**	**2**	**3**	**2**
	CO 5	**2**	**2**	**2**	**2**	**1**	**2**
	CO 6	**2**	**2**	**1**	**3**	**2**	**2**

SEMESTER FOURTH

IK Gujral Punjab Technical University
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MTFT-621-18: Dissertation-II

L	T	P
0	0	32

A student is required to undertake a Dissertation II of 16 credits on a topic approved by the supervisor, the Departmental Research Committee (DRC) and external expert. The Dissertation II shall be evaluated at the end of the Semester IV as per notification no. IKGPTU/Reg/NF/157 dated 04/04/2019.

Scheme & Syllabus of

Ph.D. - Food Science & Technology

Batch 2020 onwards

By

Board of Study (Food Science & Engineering)
Department of Food Science & Technology (Main Campus)
IK Gujral Punjab Technical University

Program Outcomes

PO1 Learning to conduct innovative and high quality research to solve emerging problems in Food Science and Technology through applying the fundamental scientific knowledge and designing and conducting research experiments and analysing the findings.

PO2 Conceptualizing and solving scientific and technological problems through lateral and original thinking and evaluating a wide range of potential solutions for those problems to arrive at feasible and optimal solutions after considering public health, food safety, food preservation, novel value-added product development, nutritional enhancement and food security as core areas of expertise.

PO3 Doctoral students will attain professional and leadership skills for professional positions in food and allied industries, government, or research institutes.

PO4 Communication skills and professional approach to convey technical information and defend scientific findings within the scientific community by presenting research to local, regional, and national audiences through publications, report writings and presentations will be enhanced.

PO5 Developing skills and competencies in budding researchers and inculcating the requisite aptitude in them to conduct advanced research in the emerging areas of food science and technology with a rigorous and scientific approach.

Corse Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
PHDFT-101-20	Compulsory Course	Research Methodology	3	1	0	40	60	100	4
PHDFT-101-20		Research and Publication Ethics	2	0	0	20	30	50	2
PHDFT-201-20	Core Theory Course (Any one)	Advances in Food Processing Technology	3	1	0	40	60	100	4
PHDFT-202-20		Advances in Food Analysis	3	1	0	40	60	100	
PHDFT-203-20		Advances in Food Packaging	3	1	0	40	60	100	
PHDFT-204-20		Processing Technology for Bioactive Compounds	3	1	0	40	60	100	
PHDFT-301-20	Interdisciplinary Course (Any One)	Intellectual Property Rights	3	1	0	40	60	100	4
PHDFT-302-20		Product Design & Development	3	1	0	40	60	100	
PHDFT-303-20		Project Planning & Implementation	3	1	0	40	60	100	
PHDFT-304-20		Food Supply Chain Management	3	1	0	40	60	100	
PHDFT-401-20	Core Presentation	*Presentation	0	0	6	75	-	75	3
		Total	**11**	**3**	**6**	**215**	**200**	**425**	**17**

***Minimum two presentation related to proposed research area of the candidate**

***Non-University Exam**

COMPULSORY COURSE

PHDFT-101-20: Research Methodology

Total Marks: 100

L	T	P
3	1	0

Objectives:

1. To acquire the knowledge of fundamental of research.
2. To develop understanding about planning and designing a research problem.
3. To understand various statistical tools for data analysis.
4. To develop the skills related to research publication and thesis writing.

Course outcome:

1. The students would be acquainted with knowledge related to concept, types and objective of research.
2. Knowledge of fundamentals of planning and hypothesising a research problem and designing the experiments would be helpful in effective pursuance of the research objectives.
3. The students would be acquainted with the effective means of writing, compiling, presenting and discussing the findings of the experiments and their further publications in the reputed journals.
4. Knowledge of statistical tools would be instrumental in drawing inferences and conclusive reports from the laboratory experiment results.

Course Content:

Unit I

Introduction: Definition, general and specific characteristics of research, classification, types and objective of research, steps in research process, criteria of good research, basic concept of experiments and research, significance of research.

Planning and designing a research study: choosing a research topic, literature review, research problem formulation, articulating hypothesis, selection of variables, formulation of objectives, research participants.

Unit II

Research methodology and experimental design: Materials and methods, Meaning, nature and types of data: primary and secondary; observational; experimental. Data Collection: types of sampling design and sampling techniques**,** characteristics of a good sample**,** sampling and non sampling errors, preparation of samples, Principles of research design and methodology, general types of research designs and approaches, compilation and documentation of data.

Unit III

Statistical applications and data analysis: An overview of application of central tendency and dispersion, standard deviation, standard error of mean, coefficient of variation, variance, population null hypothesis, level of significance and confidence, power of test, one tail and two tail test, parametric tests: definitions and applications of t-test for one and two sample

means, F test for two variances, analysis of variance (ANOVA) (One way and two way), Basic of correlation and regression analysis.

Unit IV

Thesis writing/ research papers/ review articles: significance of writing of thesis/ research papers/ review articles and presentation, Format of the research report**,** style of writing the report**,** references and bibliography, effective presentation and discussion of results/findings, intellectual property rights and plagiarism.

Books Recommended

1 Basotia, G.R. and Sharma, K.K. 2009. *Research methodology*
2 Chaudhary, C.M. 2009. *Research methodology*, RBSA Publications
3 Kothari, C.R. 2004. *Research methodology: Methods and Techniques*
4 Gupta, S. P. 2008. *Statistical Methods,* Sultan Chand and Sons, New Delhi.
5 Gupta, S.C. & Kapoor, V.K. 2003. *Fundamentals of Mathematical Statistics.* S. Chand & sons.

Mapping of course "Research Methodology – PHDFT-101-20" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	3	3	2	3
	CO 2	3	3	3	3	3
	CO 3	2	2	3	3	1
	CO 4	3	3	3	3	2

PHDFT-102-20: Research and Publication Ethics

Total Marks: 50	L	T	P
	2	0	0

Objective:

1. Awareness of students about philosophy and ethics about publication.
2. Introduce students to the Intellectual honest and research integrity.
3. To impart knowledge of various tools for plagiarism checking.
4. To know about the databases and research metrics.

Course Outcome: After the completion of the course, the students will be able to:

1. Learn the best practices for publication ethics
2. Understand the Ethics with respect to science and research.
3. To know about the various databases sources.
4. Learn about the various tools for plagiarism checking.

Course Content:

Unit I

PHILOSOPHY AND ETHICS: Introduction to philosophy: definition, nature and scope, concept, branches; Ethics: definition, moral philosophy, nature of moral judgments and reactions

SCIENTIFIC CONDUCT: Ethics with respect to science and research, Intellectual honest and research integrity, Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP),Redundant publication: duplicate and overlapping publications, salami slicing ,Selective reporting and misrepresentation of data

Unit II

PUBLICATION ETHICS : Publications ethics: definition, introduction and importance **,**Best practices/standard setting initiative and guideline: COPE, WAME, etc.**,** Conflicts of interest **,**Publication misconduct: definition, concepts, problems that lead to unethical behavior and vice versa, types**,**Violation of publication ethics, authorship and contributorship **,** Identification of publication misconduct, complaints and appeals**,**Predatory publisher and journals

Unit III

OPEN ACCESS PUBLISHING : Open access publications and initiatives**,** SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies**,** Software tool to indentify predatory publication developed by SPPU, Journal finder/ journal suggestion tools viz. JANE, Elsevier journal finder, Springer Journal suggester, etc.

PUBLICATION MISCONDUCT: Subject specific ethical issues, FFP, authorship **,**Conflicts of interest, Complaints and appeals: examples and fraud from india and abroad

Unit IV

SOFTWARE TOOLS: Use of plagiarism software like Turnitin, Urkund and other open source software tools

DATABASES AND RESEARCH METRICS : Databases : Indexing databases **,**Citation databases: Web of Science, Scopus etc.

RESEARCH METRIC: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score, Metrics: h-Index, g index, i10 index, altmetrics

Mapping of course "PHDFT-102-20: Research and Publication Ethics "outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	3	3	2	3
	CO 2	3	3	3	2	3
	CO 3	3	3	3	2	3
	CO 4	3	3	3	3	3

CORE THEORY COURSE

PHDFT-201-20: Advances in Food Processing Technology

Total Marks: 100	L	T	P
	3	1	0

Objectives:

1. To acquire knowledge of emerging / alternative technologies applied to food processing.
2. To enable a student to know the relative advantages / disadvantages over existing technologies.
3. To understand the economics and commercialization of newer technologies.
4. To study about microbial safety of foods by emerging methods.

Course Outcome: On completion of the subject, the students will be able to:

1. Develop an appreciation about need of different emerging techniques used in food processing and preservation.
2. Apply their knowledge on high pressure processing, pulsed electric processing, and hurdle technology in various food industries.
3. Understand the concepts related to membrane technology, supercritical fluid extraction and quality assessment of food using ultrasonic techniques.
4. Get an overview on principles, mechanism and application of nanotechnology in food.

Course Content:

Unit I

Membrane technology: Introduction to membrane processes: micro- filtration, UF, NF and RO and their industrial application.

Supercritical fluid extraction: Concept, extraction methods and its application.

Unit II

Microwave and radio frequency processing: Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying.

Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

Unit III

High Pressure processing: Concept, equipment's for HPP treatment, mechanism of microbial inactivation and its application in food processing.

Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques.

Unit IV

Newer techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation.

Nanotechnology: Principles and applications in foods.

Suggested Readings

- Barbosa-Canovas 2002. *Novel Food Processing Technologies*. CRC.
- Dutta AK & Anantheswaran RC.1999. *Hand Book of Microwave Technology for Food Applications*.
- Frame ND. (Ed.). 1994. *The Technology of Extrusion Cooking*. Blackie.
- Gould GW. 2000. *New Methods of Food Preservation*. CRC.
- Shi J. (Ed.). 2006. *Functional Food Ingredients and Nutraceuticals:Processing Technologies*. CRC.

Mapping of course "Advanced Food Process Technology- PHDFT-201-20" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	3	2	2	3
	CO 2	3	3	2	2	3
	CO 3	3	3	2	2	3
	CO 4	3	3	2	2	3

PHDFT-202-20: Advances in Food Analysis

Total Marks: 100	L	T	P
	3	1	0

Objectives:

1. To develop an understanding about the advanced analytical and instrumental techniques.
2. To illustrate the principle and mechanism of analytical instruments.
3. To describe bio-chemical analysis of food components.

Course Outcomes: After the completion of the course, the students will be able to:

1. Have a thorough knowledge about the applications various analytical and instrumental techniques.
2. Understand the mechanisms and principle behind various analytical techniques.
3. Acquaint with the spectroscopic, chromatographic and microscopic techniques
4. Comprehend the field of electrophoresis and textural properties.

Course Content:

Unit I

Spectroscopy: UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometry, Fluorescence spectroscopy, Emission spectroscopy, Mass-spectroscopy, Fourier Transform Infra-Red.

Unit II

Methods of separation and analysis of biochemical compounds and macromolecules: Principles and applications of Gas Chromatography, High Performance Liquid Chromatography, Thin layer chromatography.

Unit III

Microscopic techniques: Light microscopy, Scanning electron microscopy, Transmission electron microscopy, particle size analysis, Thermal techniques in food analysis: Differential scanning calorimetry and Thermo gravimetric analysis.

Unit IV

Electrophoresis: Different kinds of electrophoresis, western blotting, gel documentation, Concept of rheology, Textural properties: Classification, objective methods of texture evaluation, Measurement of texture, structural aspects of food texture, engineering approach and techniques for evaluation of food texture.

Recommended Readings:

1. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier
2. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* (3 ed.): CBS Publications, New Delhi.
3. Winton, A. L. (2001). *Techniques of Food Analysis:* Agrobios, Jodhpur.
4. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.
5. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.

6. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons. Food Texture and Viscosity; Concept and Measurement; Malcolm C. Bourne; An Elsevier Science Imprint.
7. *Rheological Methods in Food Process Engineering*; James F. Steffe; Freeman Press.

Mapping of course "PHDFT-202-20: Advances in Food Analysis" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	2	3	2	3
	CO 2	3	2	3	2	3
	CO 3	3	2	3	2	3
	CO 4	3	2	3	2	3

PHDFT-203-20: Advances in Food Packaging

Total Marks: 100

L	T	P
3	1	0

Objective:

1. The purpose of this course is to explain the various recent techniques of food packaging, applications, principles and requirements of these techniques.
2. Identify the purpose, principle and advance knowledge related to the various packaging technology systems.
3. Awareness of students about the recycling of packaging materials, biodegradable packaging materials and safety and legislative aspects.

Course Outcome: On successful completion of the subject, the students will be able to:

1. Comprehend advance knowledge on the properties and production of various packaging materials and effect of various indicators used in supply chain management to indicate the food quality
2. Understand various types of scavengers and emitters for improving the food shelf life.
3. Learn about consumer response about new packaging systems and safety and legislative requirements
4. Acquaint about food-package interaction between package-flavour, gas storage systems for food storage, recycling and use of green plastics for reducing the pollution and their effect on food quality.

Course Content:

Unit I

Active and intelligent packaging techniques, oxygen, ethylene and other scavengers: Oxygen scavenging technology, selection of right type of oxygen scavengers, ethylene scavenging technology, carbon dioxide and other scavengers, antimicrobial food packaging, antimicrobial packaging system, effectiveness of antimicrobial packaging.

Unit II

Advantages of non-migratory bioactive polymers, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, defining and classifying time temperature indicators (TTIs), requirements for TTIs, development of TTIs, maximizing the effectiveness of TTIs to monitor shelf-life during distribution, use of freshness indicator in packaging: Compounds indicating the quality of packaged food products, pathogen indicators, moisture regulation: Silica gel, clay, molecular sieve, humectants, irreversible adsorption.

Unit III

Developments in modified atmosphere packaging (MAP): Novel MAP applications for fresh-prepared produce, novel MAP gases, testing novel MAP applications, Applying high O_2 MAP. Combining MAP with other preservation techniques, packaging-flavor interactions:

Factors affecting flavor absorption, role of the food matrix, role of differing packaging materials.

Unit IV

Modern packaging systems: Green plastics for food packaging, problem of plastic packaging waste, range of biopolymers, developing novel biodegradable materials, Integrating intelligent packaging**:** role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and time temperature indicators, traceability: radio frequency identification, recycling packaging materials: recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, methods for testing consumer responses to new packaging concepts.

Recommended Readings:

1. Jung, H. H. (2014). *Innovations in Food Packaging*: Oxford, London.
2. Ahvenainen. R. (2003). *Novel Food Packaging Techniques*: CRC Publications.
3. Robertson, G. L. (2010). *Food Packaging and Shelf Life*: CRC Publications, New York.
4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2 ed.): CRC Publications, Boca Raton.

Mapping of course "PHDFT-203-20: Advances in Food Packaging" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	1	3	3	3
	CO 2	1	2	1	2	1
	CO 3	1	1	2	1	2
	CO 4	2	3	1	3	2

PHDFT-204-20: Processing Technology for Bioactive Compounds

Total Marks: 100	L	T	P
	3	1	0

Objective:

Objectives:

1. To know the structural properties, sources and importance of bioactive compounds.
2. To impart knowledge of different extraction methods of bioactive compounds
3. To impart knowledge of different analysis methods of bioactive compounds
4. To impart knowledge of encapsulation methods of bioactive compounds

Course Outcome: On successful completion of the subject, the students will be able to:

1. Comprehend advance knowledge on the properties and extraction of various bioactive compounds
2. Understand various types of free radicals and bioactive compounds.
3. Learn about different analysis methods of bioactive compounds
4. Acquaint about interaction between encapsulation materials and bioactive compounds.

Course Content:

Unit I

Bioactive compounds: Introduction, Definition, Classification of bioactive compounds and Fun bnctional foods, Health benefits. Selection and Preparation of Plant and Plant Parts for Phytochemical Analysis: Introduction, collection and Selection of Plant and Plant Parts, Pre-preparation Technique (Cleaning, Drying, Packaging of Dried Plants, grinding, peeling etc.);

Methods of Extraction: Introduction, Organic Solvent Extraction, Extraction with Supercritical Gases, Steam Distillation, Extraction of Essential Oil, Soxhlet Extractor, Accelerated Solvent Extractor, Purification and Concentration of Miscella, Schemes of procedure for extracting Plant Tissues, Other Minor Extraction Methods, Advances in extraction techniques (Ultrasound extraction, microwave extraction etc).

Unit II

Antioxidants**:** Concept of free radicals and antioxidants; antioxidants role as nutraceuticals and functional foods. Invitro study of antioxidant activities and polyphenols.
Qualitative and Quantitative Estimation of Bioactive compounds: Introduction, Gas Chromatography, Liquid Chromatography, High Performance Liquid Chromatography: Introduction, Theoretical Principles, overview of instrument, sample handling, interpretation of the produced data.

Introduction, Theoretical Principles, overview of instrument, sample handling, interpretation of the produced data – Spectroscopy; Ultraviolet Spectroscopy; Infrared Absorption Spectroscopy; Near- Infrared Absorption Spectroscopy; Mass Spectroscopy.

Unit III

Properties and functions of various bioactive compounds/functional food ingredients: Sources and role of phenolic acids, flavonoids, carotenoids, lycopene, anthocyanin. tocotrienols, chlorophyll, polyunsaturated fatty acids, terpenoids. Protein, complex carbohydrates like dietary fibers as functional food ingredients; probiotic, prebiotics and symbiotic foods, and their functional role.

Different foods as functional food: cereal products (oats, wheat bran, rice bran, etc.), fruits and vegetables, milk and milk products, legumes, nuts, oil seeds and sea foods, herbs, spices and medicinal plants. Beverages (tea, coffee, cocoa, wine, beer) as functional foods/drinks and their protective effects.

Unit IV

Encapsulation and delivery of bioactive compounds: Introduction, Designing of delivery systems incorporated with food bioactive components encapsulation and delivery systems – Emulsion, spray drying, freeze drying, co-extrusion, microencapsulation and Nano-laminated Biopolymer Structures in Foods;

Reference Books

1. *Functional Foods: Biochemical and Processing Aspects*, Volume 1. Giuseppe Mazza. CRC Press.
2. *Handbook of Nutraceuticals and Functional Foods,* Second Edition. Robert E.C. Wildman. CRC Press.
3. *Dietary Supplements of Plant Origin*. Massimo Maffei. CRC Press.
4. *Nutraceutical beverages Chemistry, Nutrition and health Effects.* Fereidoon Sahidi, Deepthi K. Weerasinghe. American Chemical Society.
5. *Vegetables, fruits, and herbs in health promotion.* Ronald R. Watson. CRC Press.
6. *Fruit and Cereal Bioactives: Sources, Chemistry, and Applications.* Özlem Tokusoglu; Clifford Hall III. CRC Press.
7. *Natural Products from Plants*. Leland J. Cseke; Ara Kirakosyan Peter B. Kaufman; Sara L. Warber James A. Duke; Harry L. Brielmann. CRC Press

Mapping of course "PHDFT-204-20: Processing Technology for Bioactive Compounds" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	3	2	1	3
	CO 2	3	3	2	1	3
	CO 3	3	3	2	2	3
	CO 4	3	3	2	1	3

INTERDISCIPLINARY COURSE

PHDFT-301-20: Intellectual Property Rights

Total Marks: 100	L	T	P
	3	1	0

Objective:

1. To sensitize the students regarding the essentials of Intellectual Property Rights,
2. To describe the fundamentals of Intellectual Property Rights,
3. legislations and significance to it in the development of agriculture, food and nutritional security.
4. To describe the procedure of commercial transfer and acquisition of technology.

Course Outcome: After the completion of the course, the students will be able to:

1. Acquaint the students with different IPR and its their importance in protecting individual rights.
2. Understand the Indian Legislations for the protection of various types of Intellectual Properties.
3. Understand the relation between WTO and IPR with Economic Development.
4. Have knowledge regarding licensing and the technology transfer to industry.

Course Content:

Unit I

Need for the introduction of Intellectual Property Right regime; GATT and WTO, WTO and Economic Development, IPR Protection and Economic Development, TRIPs and various provisions in TRIPS Agreement.

Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties.

Unit II

Fundamentals of patents, copyrights, geographical indications, designs and layout, trademarks: Introduction, Procedure, Infringement

Unit III

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection. Introduction of WIPO.

Unit IV

International Treaty on Plant Genetic; Licensing and the Transfer of Technology: Introduction, The Commercial Transfer and Acquisition of Technology, Negotiation of Licensing Agreements, Remuneration, Material transfer agreements, Research collaboration Agreement.

***Recommended Readings*:**

1. Rashmi Aggarwal and Rajinder Kaur, *Patent Law and Intellectual Property in the Medical Field,* IGI Global
2. Arthur Miller and Michael Davis, *Intellectual Property, Patents, Trademarks, and Copyright in a Nutshell (Nutshells),* West Academic Publishing
3. Silke von Lewinski (Edited), *Indigenous Heritage and Intellectual Property,* Genetic Resources, Traditional Knowledge and Folklore, 2nd Edition, (2008), Wolters Kluwer.
4. Paul L.C. Torremans (edited), *Intellectual Property and Human Rights,* Enhanced edition of Copyright and Human Rights, (2008), Wolters Kluwer.
5. Dr. T. Ramakrishan (Edited), *Biotechnolgy and Intellectual Property Rights* (2003), CIPRA, NLSIU, Bangalore.
6. Pat Roy Mooney, *The Law of the Seed: Another Development and Plant Genetic Resources,* Development Dialogue, 1983
7. Daniel Gervais (edited), *Intellectual Property, Trade and Development* (2007), Oxford University Press.
8. Peter – Tobias Stoll, Jan Busche and Katrin Arend (Edited), *WTO-Trade related Aspects of Intellectual Property Rights* (2009) (Vol. 7), Martinus Nijhoff Publishers.
9. A.H. Qureshi, *Interpreting WTO Agreements*, Cambridge.

Mapping of course "PHDFT-301-20: Intellectual Property Rights"outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	**PO2**	**PO3**	**PO4**	**PO5**
Course Outcome (CO)	**CO 1**	**1**	**2**	**3**	**3**	**2**
	CO 2	**1**	**1**	**3**	**3**	**2**
	CO 3	**1**	**1**	**3**	**3**	**2**
	CO 4	**1**	**2**	**3**	**3**	**2**

PHDFT-302-20: Product Design & Development

Total Marks: 100	L	T	P
	3	1	0

Objective:

1. To understand the fundamental of product design and development.
2. To understand the consumer role in product development.
3. To acquire the knowledge about the various steps involved in product development process.
4. To understand the legal aspects of new product launch.

Course Outcome: After the completion of the course, the students will be able to:

1. Understand the concept of product design and development.
2. Grasp the role of consumers in product development.
3. Learn about product development technology and technological knowledge about marketing and distribution.
4. Understand the various product development process.

Course Content:

Unit I

Concept of product development - product success and failure, factors for success, process of product development, managing for product's success.

Innovation strategy - possibilities for innovation, building up strategy, product development programme.

Unit II

The product development process - product strategy, product design and process development, product commercialization, product launch and evaluation.

Role of consumers in product development - consumer behaviour, food preferences, avoiding acceptance, integration of consumer needs in product development and sensory needs.

Unit III

The knowledge base for product development technology - knowledge and the food system, knowledge management, knowledge for conversion of product concept to new product, technological knowledge (product qualities, raw material properties, processing, packaging requirement, distribution and marketing.

Unit IV

Managing the product development process, - principles of product development management, people in product development management, designing the product

development process, key decision points, establishing outcomes, budgets and constraints, managing and organizing product development process.

Improving the product development process - key message, evaluating product development, innovative matrices, striving for continuous improvement, Improving success potential of new products, market exploration and acquisition, Legal aspects of new product launch.

Suggested Readings

1. Clarke & Wright W. 1999. *Managing New Product and Process Development.* Free Press.
2. Earle and Earle 2001. *Creating New Foods.* Chadwick House Group.
3. Earle R, Earle R & Anderson A. 2001. *Food Product Development.* Woodhead Publ.
4. Fuller 2004. *New Food Product Development* - from Concept to Market Place. CRC.

Mapping of course "PHDFT-302-20: Product Design & Development "outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	1	1	1	2
	CO 2	1	2	2	3	1
	CO 3	2	3	1	2	2
	CO 4	1	2	2	1	1

PHDFT-303-20: Project Planning & Implementation

Total Marks: 100	L	T	P
	3	1	0

Objective:

5. Awareness of students about fundamentals of project management.
6. Introduce students to the methodology of project formulations and the implementation procedures and strategic planning of new projects.
7. To impart knowledge of project deliverables
8. To know the execution of the project plan and evaluating project progress.

Course Outcome: After the completion of the course, the students will be able to:

5. Learn the strategies of project management
6. Understand the resources planning, cost and budget management.
7. Execute the project plan and evaluation of project progress.
8. Learn about the project quality standards and measurement of performance of those standards.

Course Content:

Unit I

An introduction to project management: An overview of project management. The differences between Product, Project and Program management, Industrial, R&D and social security projects.

Successful Initialization and Project Planning: Defining the project scope. Establishing the project scope and defining project deliverables. Defining and Sequencing of Project Deliverables. Project scheduling techniques, Market research and forecasting. GMP and HACCP.

Unit II

Resource Planning: Determining resource requirements and acquiring those resources, Source of finance, Debt-equity ratio, Debt service coverage ratio, ROI, RONW, Process of soliciting and selecting vendors for material and services for the project. Cost Management. Establishing the project budget and analyzing budget variances, techno-economic feasibility analysis.

Unit III

Execution of the Project Plan and Evaluating Project Progress: Execution of the project plan and activities required to create the project team, monitor progress against the plan, and keep the project on track. Capacity utilization, Breakeven point.

Unit IV

Risk Identification and Analysis: Identify risky events, measure the element of risk, and develop responses to high-risk events. Establishing the Project Management Team Identifying project team members, and structuring a successful project team. Keeping the Project on Track The quality process, Project's quality standards and how performance to those standards will be measured. Managing Project Change Handling formal and informal change, how to identify and evaluate change, and incorporate change into the project plan.

Suggested Readings

Pavlyak MM.2000. *Systems Survival Guide*. Ruby Moon Press.
Thomsett TC.1990. *The Little Book of Project Management*. American Management Association.

Mapping of course "PHDFT-303-20: Product Design & Development"outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	3	3	3	2	3
	CO 2	3	3	3	2	3
	CO 3	3	3	3	2	3
	CO 4	3	3	3	3	3

PHDFT-304-20: Food Supply Chain Management

Total Marks: 100	L	T	P
	3	1	0

Objective:

1. Study the concept, applications, systems and practices of food supply chain management in food industry.
2. Understanding the primary difference between logistic and supply chain management.
3. Understanding of the management components of supply chain management.
4. Knowledge about the professional opportunities in supply chain management.

Course Outcome: After the completion of the course, the students will be able to:

1. Learn the individual process of supply chain management and their interrelationship within individual companies and across the supply chain.
2. Grasp the supply chain information system and integrating the supply chain
3. Understand the concept of supply chain inventory management.
4. An understanding of tools and techniques useful in implementing the supply chain management.

Course Content:

Unit I

Building blocks of supply chain network, performance measures, decisions in supply world and models.

Unit II

Supply chain inventory management, economic order quantity models, recorder point models, multi echelon inventory systems.

Unit III

Use of stochastic models and combinatorial optimization in SC planning, layout, capacity planning, inventory optimization, dynamic routing and scheduling.

Unit IV

Internet technologies and electronic commerce in SCM related to ERP, Q procurement, e-logistics, internet auctions, e-market, electronic, business process optimization.

Suggested Readings

1. Chopra S & Meindel P. 2002. *Supply Chain Management: Strategy, Planning and Operation.* Prentice Hall.

2. Handfield RB & Nochols EL.1999. *Introduction to Supply Chain Management.* Prentice Hall.
3. Hopp WJ & Spearman ML. 1996. *Factory Physics: Foundations of Manufacturing Management.* McGraw Hill.
4. Levi DS, Kaminsky P & Levi ES. 2000. *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies.* Mc Graw Hill.
5. Shapiro JF. 2001. *Modeling the Supply Chain.* Duxbury Thomson Learning.
6. Tayur S, Ganeshan R & Magazine M.1999. *Quantitative Models for Supply Chain Management.* Kluwer Academic Publ.
7. Viswanadham N. 2000. *Analysis of Manufacturing Enterprises.* Kluwer.
8. Viswanadham N & Narahari Y. 1998. *Performance Modeling of Automated Manufacturing Systems.* Prentice Hall.

Mapping of course "PHDFT-304-20: Food Supply Chain Management" outcomes and Program outcomes:

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)						
	Program Outcome (PO)					
		PO1	PO2	PO3	PO4	PO5
Course Outcome (CO)	CO 1	1	2	2	1	2
	CO 2	2	2	2	1	2
	CO 3	1	2	2	1	2
	CO 4	2	2	2	1	2

BSFT211-21: FOOD MICROBIOLOGY

Total Marks: 100	L	T	P
	4	0	0

Course objective: To understand the role and significance of microbes of different categories, microbial inactivation and environmental factors that affect them in foods.

UNIT I

Introduction to Food Microbiology: History and Development of Food Microbiology; Definition and Scope of food microbiology, Inter-relationship of microbiology with other sciences

Characteristics of Microorganisms in Food: Types of microorganisms associated with food, their morphology and structure; Significance of spores in food microbiology

UNIT II

Microbial Growth in Food: Bacterial growth curve and microbial growth in food; Factors affecting the growth of micro-organisms in food: Intrinsic and extrinsic factors; Biochemical changes caused by micro-organisms

Microbial Food Spoilage: Sources of Microorganisms in foods, Some important food spoilage microorganisms; Spoilage of specific food groups- Milk and dairy products, Meat, poultry and seafoods, Cereal and cereal products, Fruits and vegetables and Canned products.

UNIT III

Food Fermentations: Fermentation–definition and types; Microorganisms used in food fermentations; Dairy Fermentations-starter cultures and their types , concept of probiotics, Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso, soya sauce, beer, wine and traditional Indian foods

Foodborne Diseases: Types – foodborne infections, foodborne intoxications and toxic infections; common and Recent Examples

Cultivation of Micro-organisms: Pure culture technique; Methods of isolation and cultivation; Enumeration of Microorganisms- qualitative and quantitative

UNIT IV

Control of Microorganisms in Foods: Principles and methods of preservation; Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment (esp. thermobacteriology), Irradiation, Biopreservatives esp. Bacteriocins, Introduction to Hurdle concept and Non Thermal methods

Trends in Food Microbiology: Rapid Methods of Detection, Recent Advances

Recommended readings:

1. Frazier, W. C. and Weshoff, D. C. (2015). *Food Microbiology*: Tata McGraw Hill Publication, New Delhi.

2. Adam, M. R. & Moss, M. O. (2008). *Food Microbiology:* Royal Society of Chemistry, Cambridge.
3. James, M. J. (2005). *Modern Food Microbiology* (5th ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5th ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applicants.* Prentice Hall, New Jersey.
6. Garbutt, John. Essentials of Food Microbiology, Arnold, London, 1997
7. Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993

Course Outcomes:

1. Understand the principles involving food spoilage and preservation involving microorganisms and explain why microbiological quality control programmes are necessary in food production.
2. Ability to identify the characteristics of important pathogens and spoilage microorganisms in foods.
3. Understand the role and significance of intrinsic and extrinsic factors on growth of microorganisms in foods and differentiate which organisms would be likely to grow in a specific food product.
4. Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated killed or made harmless in foods and identify ways to control microorganisms in foods.
5. Describe the beneficial role of microorganisms in fermented foods and in food processing.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	2	2	1
PO2	1	1	1	1	1
PO3	1	2	2	2	1
PO4	1	1	2	1	2
PO5	1	2	1	2	2

BSFT212-21: FOOD CHEMISTRY – I

Total Marks: 100

L	T	P
4	0	0

Course objective: To acquaint the students about chemistry, properties and effects of processing on food components.

UNIT I

Introduction to Food Chemistry: Definition, Composition of food

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

Lipids: Classification of lipids, Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. Chemical properties-reichert meissel value, polenske value, iodine value, peroxide value, saponification value. 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

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 eg. organoleptic, solubility, viscosity, binding gelation / texturization, emulsification , foaming. Effect of different processing on proteins.

UNIT III

Carbohydrates: Classification (mono, oligo and poly saccharides); Structure of important polysaccharides(starch, glycogen, cellulose, pectin, hemicellulose, gums); Chemical reactions of carbohydrates –oxidation, reduction , with acid & alkaki; Modified celluloses and starches. Effect of different processing on carbohydrates.

UNIT IV

Vitamins: Structure, Importance and Stability; Water soluble vitamins; Fat soluble vitamins, Effect of different processing on vitamins.

Recommended readings:

1. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
2. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
3. Wong, Dominic WS, Food Enzymes, Chapman and Hall, New York, 1995
4. Potter,N.N.and Hotchkiss,J.H, Food Science, 5th Ed., Chapman & Hall,1995
5. DeMan, J.M., Principles of Food Chemistry, AVI, NewYork, 1980

Course Outcomes:

1. Students shall be aware of the underlying chemistry, properties and effects of processing on food components.
2. Understanding of food components reactions and their impact on sensory, nutritional, and functional properties of foods.
3. Ability to identify the structure of food constituents and relate the structure to the constituents function and importance in foods with respect to food quality, nutrition, safety, processing, etc.

4. Ability to explain influence of factors such as temperature, pH, ionic characteristic and strength, bonding, etc. on chemical changes in food systems and judge how to adjust these conditions to improve or minimize chemical and biochemical deterioration of food systems.

5. Ability to integrate chemistry and biochemistry principles into real-world food science and nutritional problems.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	2	1	3	1
PO2	3	2	1	3	1
PO3	3	3	1	2	1
PO4	3	2	2	3	1
PO5	1	2	2	2	1

BSFT213-21: TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS

Total Marks: 100

L	T	P
4	0	0

Course objective: To develop knowledge regarding biochemistry and physiology of fruits and vegetables and their role in pre- and post-harvest changes in product quality.

UNIT 1

INTRODUCTION: Importance of fruits and vegetable, history and need of preservation, reasons of spoilage, method of preservation (short & long term). Classification and composition of fruits and vegetables and their nutritional significance. Physical and chemical indices of fruit maturity, crop maturity and ripening

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

FRUITS BEVERAGES: Introduction, 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.

JAMS, JELLIES AND MARMALADES: Introduction**,** Jam: Constituents, selection of fruits, processing & technology**,** Jelly: Essential constituents(Role of pectin, ratio), Theory of jelly formation, Processing & technology, defects in jelly**,** Marmalade : Types, processing & technology, defect

UNIT III

PICKLES, CHUTNEYS AND SAUCES: Processing , Types, Causes of spoilage in pickling**.**

TOMATO PRODUCTS: Selection of tomatoes, pulping& processing of tomato juice, tomato puree, paste, ketchup, sauce and soup.

DEHYDRATION OF FOODS AND VEGETABLES: Sun drying & mechanical dehydration, process variation for fruits and vegetables, packing and storage**.**

UNIT IV

SPICES: Processing and properties of major and minor spices, essential oils & oleoresins, adulteration**.**

TEA, COFFEE AND COCOA: Processing, Variety and Products.

Recommended Readings:

1. Jongen, W. (2002). *Fruit and vegetable processing: Improving Quality:* Woodhead Publishing, Boca raton.
2. Thompson, A. K. (1996). *Post-harvest Technology of Fruit and Vegetables:* Blackwell, Australia.
3. Thompson, A. K. (2003). *Fruits and Vegetables- Harvesting, Handling and Storage:* Blackwell, Oxford.
4. Verma, L. R. & Joshi, V. K. (2000). *Post-harvest Technology of Fruits and Vegetables:* Indus, New Delhi.
5. Srivastava, R. P. & Kumar, S. (2001). *Fruit and Vegetable Preservation– Principles and Practices (3 ed.):* International Book distributing Co., Lucknow (India).
6. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
7. W B Crusess.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
8. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers
9. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, Second edition.
10. Srivastava, R.P. and Kumar, S. 2006 . Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.

Course Outcomes:

1. The students shall be able to understand Biological, Chemical & Physical Properties of Fruits & Vegetables.
2. The students shall be able to understand Technologies involved in Processing, Preservation & Value- Addition of Fruits & Vegetables.
3. Students shall be able to understand Industrial Processes for Commercial Production of Jams, Jellies, Marmalade, Fruit Juices, Concentutes, Fruit Juice Powder, Dehydrated Fruits, and Canning of Fruits & Vegetables.
4. Students shall be able to understand Basics of New Food Products Development & Ideas Generation for Product Development.
5. Students shall be able to understand Basics of By Product Utilization & Waste Utilization related to Fruits & Vegetables.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	1	1
PO3	2	1	2	3	1
PO4	3	2	3	1	2
PO5	3	1	1	1	1

BSFT214-21: FOOD MICROBIOLOGY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective: To understand the microbial techniques and to develop skills related to microbial quality evaluation of foods using various techniques.

Course Content

1. Introduction to the Basic Microbiology Laboratory Practices and Equipment's
2. Functioning and use of compound microscope
3. Cleaning and sterilization of glassware
4. Preparation and sterilization of nutrient broth
5. Cultivation and sub-culturing of microbes
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's staining
10. Standard Plate Count Method
11. Microbiology of raw and processed foods:
    a. Microbiological analysis of food products-
        i. Bacterial count,
        ii. Yeast and mold count,
        iii. Coliform count,
        iv. Standard plate count of milk and direct microscopic count of milk,
        v. Reductase Test (MBRT).
    b. Microbiological testing of water-
        i. Quantitative test,
        ii. Bacteriological quality testing (MPN).

Course Outcomes:

1. Acquire the practical skills for the sampling of foods to carry out microbial analysis.
2. Ability to carry out various sterilization techniques and to identify the most suitable technique for specific food.
3. Ability to isolate and identify common food borne microbial pathogens.
4. Understand microbiological analysis methods for food products and ability to analyze different foods for presence of hazardous microorganisms using food microbiology technology.
5. Ability to interpret microbiological analysis of food products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	2	2	1	1
PO2	1	2	1	1	1
PO3	3	1	2	1	2
PO4	3	2	1	1	1
PO5	3	1	1	1	1

BSFT215-21: FOOD CHEMISTRY – I (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objective:

To enable students to learn basic principles and procedure of starch, sugar and fat analysis.

Course Content

1. Preparation of primary and secondary solutions
2. Estimation of moisture content
3. Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR.
4. Determination of refractive index and specific gravity of fats and oils.
5. Determination of smoke point and percent fat absorption for different fat and oils.
6. Determination of percent free fatty acids
7. Estimation of saponification value
8. Estimation of reducing and non-reducing sugars using potassium ferricyanide method.
9. Estimation of starch content.
10. Estimation of salt content in brine
11. Estimation of salt content in butter
12. Estimation of protein in any food product
13. Estimate the ascorbic acid in any juice
14. Estimation of iodine value
15. Estimation of peroxide value

Course Outcomes: 1. Acquire the practical skills for the chemistry, properties and effects of additives on GTR.

2. Ability to carry out refractive index, specific gravity, smoke point, fat absorption for different fats and oils.

3. Ability to isolate and identify free fatty acids, saponification value, reducing and non-reducing sugars.

4. ability to estimate the salt content in different food

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	2	2	2	2
PO2	1	1	1	1
PO3	2	3	3	3
PO4	3	3	3	3
PO5	2	2	2	2

BSFT216-21: TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS

Total Marks: 50

L	T	P
0	0	4

Course objective: To enable students to learn the evaluation of the quality of fruit and vegetables.

Course Content

1. Estimation of total soluble solids (TSS).
2. Estimation of pH and acidity of product.
3. Estimation of brix: acidity ratio.
4. Estimation of ascorbic acid and effect of heat treatment on it
5. To study the steps of can making process.
6. Preparation and evaluation of pectin products.
7. Adulteration of spices.
8. Dehydration of fruits and vegetables.
9. Rehydration of fruits and vegetables.
10. Preparation and evaluation of sauce
11. Preparation and evaluation of Ketchup
12. Preparation of fruit juice products, Squash
13. Preparation and evaluation of pickle
14. Preparation and evaluation of Jam

Course Outcomes:

1. Ability to assess the quality of fruit and vegetables.
2. Ability to establish the quality specifications for the processing of fruit and vegetables.
3. Ability to develop various fruit and vegetable products with quality assurance and safety.
4. Understand principles and methods of preservation of fruits and vegetables.
5. To develop proficiency skill in preserving fruits and vegetables into various products.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	1	2	2
PO3	1	1	1	1	1
PO4	1	1	1	1	1
PO5	2	1	1	1	1

BMPD302-18 MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	1	0	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

5. Sports/NSS/NCC
6. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

BSFT221-21: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Total Marks: 100	L	T	P
	4	0	0

Course Objective: To create knowledge about the processing and quality evaluation of cereal grains.

UNIT I

TECHNOLOGY OF CEREALS: Present status and future prospects of major cereals and millets in India and world, Morphology, composition, nutritive value and properties of various food grains including cereals, pseudocereals, millets and other coarse grains.

Wheat- varieties and quality characteristics, milling process- conditioning and tempering, equipments in wheat milling- disc mill, hammer mill, roller mill, functionality in bakery products, Extruded wheat products, pasta products

Paddy- threshing, drying and storage, parboiling processes- drying, milling operations, precleaners, shellers and hullers, separators, polishers, rice mill yields and losses at different stages of milling, processed rice products.

UNIT II

Corn – Milling (wet & dry) , cornflakes, corn flour

Barley- Milling (pearl barley, barley flakes & flour)

Oats – Milling (oatmeal, oatflour & oatflakes)

Sorghum and millets – Traditional & commercial milling (dry &wet) Rye and triticale—milling (flour),uses

UNIT III

TECHNOLOGY OF OILSEEDS:

Introduction, Extraction of oil and refining, Sources of protein (defatted flour, protein concentrates and isolates), properties and uses, protein texturization, fibre spinning

UNIT IV

TECHNOLOGY OF PULSES

Pulses in India and world, Morphology, composition, nutritive value, Milling of pulses, Dry milling, Wet milling, Improved milling method

Recommended Readings:

1. Kent, N.L. 2003. Technology of Cereal, 5th Ed. Pergamon Press.
2. Chakraverty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
3. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
4. Manay, S. and Sharaswamy, M. 1987. Food Facts and Priniciples.Wiley Eastern Limited.

Course Outcomes:

1. Student will acquire the understanding of the technology for Wheat Milling & Wheat based Food Products.
2. Student will acquire the understanding of the technology for Rice Milling & Rice based other Food Products.
3. Student will acquire the understanding of working of equipments related to Wheat & Rice Milling along with equipments related to Wheat based & Rice based Food Products.
4. Student will be able to understand technology for Milling of Corn & Corn based other Food Products along with equipments.
5. Student will be able to understand technology for Oil Extraction & Oil Seed Processing along with equipments.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	1	1	1
PO2	1	1	2	1	1
PO3	1	1	1	1	1
PO4	2	2	2	2	2
PO5	1	2	2	2	2

BSFT222-21: FOOD CHEMISTRY – II

Total Marks: 100	L	T	P
	4	0	0

Course Objective: To acquaint the students about chemical processes within food products particularly minerals, pigments, enzymes and flavors.

UNIT 1

Minerals: Major and minor minerals; Metal uptake in canned foods; Toxic metals

Natural Food Pigments: Introduction and classification; Food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)

UNIT II

Enzymes: Introduction, classification, General characteristics, Enzymes in food processing, Industrial Uses of Enzymes, Immobilized enzymes

Browning Reactions in Food: Enzymatic browning, Non – Enzymatic browning, Maillard reaction, Caramelization reaction, Ascorbic acid oxidation

UNIT III

Flavour: Definition and basic tastes; Chemical structure and taste; Description of food flavours; Flavour enhancers

UNIT IV

Physico-chemical and nutritional changes occurring during food processing treatments: Drying and dehydration, Irradiation, Freezing, Canning

Recommended Readings:

1. deMan, John M., Principles of Food Chemistry ,3rd Ed., Springer 1999
2. Desrosier, Norman W. and Desrosier.,James N.,The technology of food preservation , 4th Ed.,Westport, Conn. : AVI Pub. Co., 1977.
3. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York,1996
4. Fuller, Gordon W, New Product Development From Concept to Marketplace, CRC Press,2004.
5. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002

Course outcome:

1. Students should be capable for optimizing food processing through understanding and chemical processes involved in enzymes, minerals and pigments.
2. Students have understanding and application of maillard reaction, caramelization and flavor enhancing mechanism.
3. Students will be introduced to food processing treatments like drying, irradiation, freezing and canning in terms of chemistry involved in the techniques.
4. Students will develop integrating chemical processes with technology to achieve skills in food industry.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	2
PO2	2	1	1	1
PO3	1	2	1	2
PO4	1	1	1	1
PO5	2	1	1	1

BSFT223-21: TECHNOLOGY OF MEAT, FISH AND POULTRY

Total Marks: 100

L	T	P
4	0	0

Objective: This course shall educate students about the significance and necessity of organized animal products sector, humane slaughtering of animals and poultry and value addition of meat, poultry, egg and fish.

UNIT I

Introduction: Livestock and poultry population in India, Development of meat and poultry industry in India and its need in nation's economy, Glossary of live market terms for animals and birds. Structure, composition and nutritive value of meat. Conversion of muscle into meat. Factors affecting meat quality. Post-mortem changes in meat, thaw rigor, cold shortening, pre-rigor processing.

Meat quality: Effects of feed, breed and environment on production of meat animals and their quality Meat Quality-color, flavor, texture, Water-Holding Capacity(WHC),Emulsification capacity of meat

UNIT II

Slaughter process: Slaughter, inspection and grading, Antemortem examination of meat animals, slaughter of buffalo, sheep/ goat, poultry,pig A Generic HACCP model, dressing of carcasses, post-mortem examination of meat

Preservation of meat: Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing. Sausages-processing, types and defects

UNIT III

Introduction: Status of fishery industry in India.

Chilling and Freezing of fish: Relationship between chilling and storage life, MAP, general aspects of freezing, freezing systems (air blast freezing, plate or contact freezing spray or immersion freezing, freezing on board, onshore processing, changes in quality in chilled and frozen storage, thawing.

Fish Curing and Smoking: 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.

Canning of fish: 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.

Fermented fish: Flowchart of Indigenous products- Fish sauce and Paste

Concept of other Sea foods: Crabs, lobsters, prawns, shrimps, shell- fish.

UNIT IV

Egg Industry and Egg Production Practices The egg industry, its techniques of working, General management, structure, composition and nutritive value of egg and its products.

Preservation of eggs: Refrigeration and freezing, thermal processing, dehydration, coating.

Quality identification of shell eggs: Factors affecting egg quality and measures of egg quality.

By-products of meat, fish and egg industry: Utilization of meat, fish and egg industry by-products: importance, food and non-food applications Manufacture of Natural casings, Surimi-Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparision of surimi and fish mince products. Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis (FPH)

Recommended Readings:

1. Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
2. Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
3. Pearson & Gillet Processed Meats,3 Ed, CBS Publication, New Delhi, 1997
4. Shai Barbut,Poultry Products Processing,CRC Press 2005
5. Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4th Ed. CBS Publication New Delhi, 2002
6. Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
7. Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt.Limited 2005
8. Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London,1994

Course Outcome:

1. Student shall know about the significance & necessity of organized animal product sector.
2. Students shall acquire the ability of value- addition to Meat, Poultry, Egg & Fish.
3. Student shall be well versed with processing, preservation & quality control of Meat, Egg & Fish in Food Industry.
4. Student shall be well versed with manufacturing practices of egg based, fish based and meat based by products & their processing techniques.
5. Student will be having broad knowledge of status & scope of Meat, Egg, & Poultry industry world wide.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	2	2	1	1	1
PO2	1	1	1	1	2
PO3	2	1	1	1	1
PO4	2	2	1	1	2
PO5	2	1	1	1	1

BSFT224-21: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS (LAB)

Total Marks: 50

L	T	P
0	0	4

Objective: To familiarize the students with quality tests of wheat flour and yeast with reference to bread processing and to equip them with the necessary skills for bread, biscuits and cookies processing.

Course Content

1. Estimation of different physicochemical characteristics of cereals grains.
2. Milling of different cereals grains.
3. Milling quality evaluation of wheat grains.
4. Functional quality test of wheat flour-
   a. Wet & dry gluten content

b. SDS sedimentation maltose value

c. Falling number values of wheat flour

d. Dough raising capacity of yeast.

4. Estimation of Pelenske Value of flour.
5. Estimation of Potassium Bromate in flour.
6. Fermenting power of yeast.
7. Cooking characteristics of rice.
8. Test baking of bread, biscuits and cake.
9. Effect of parboiling treatment on the milling quality of rice.
10. Effect of degree of polishing on the milling quality of rice.

Course Outcomes:

1. Student shall be well versed with Processing Techniques of Cereals.
2. Student shall be well versed with quality parameters of cereals.
3. Student will be able to understand practical implication of Milling of Wheat & Rice.
4. Student will be able to get acquaintance with machinery being utilized in Milling of Wheat & Rice.
5. Student will be able to understand Lab SOPs for above.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4	CO5
PO1	1	1	2	2	1
PO2	2	1	2	2	1
PO3	1	1	2	2	1
PO4	1	1	1	1	1
PO5	2	1	2	3	1

BSFT225-21: FOOD CHEMISTRY – II (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective:

Students shall understand the quality analysis methods and new product development concept.

Course Content

1. Estimation of total ash
2. Estimation of minerals -demo
3. Determination of thermal inactivation time of enzymes in fruits and vegetables.
4. Estimation of crude fiber
5. To determine effect of temperature on taste
6. Extraction and analysis of pigments (Chlorophyl, Lycopene, Carotenoids)
7. Extend of non-enzymatic browning by extraction methods.
8. Extraction of polyphenols from foods by different methods
9. Estimation of total phenolic content
10. Estimation of total flavonoid content
11. Estimation of total antioxidant activity
12. Estimation of ferric reducing power

Course Outcomes: 1. Ability to isolate and identify the different pigments present in different food products.

2. Ability to isolate and identify polyphenols.
3. ability to estimate the mineral content in different food
4. Ability to determine the effect of temperature on tase.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	2	2	2	2
PO2	1	1	1	1
PO3	2	3	3	3
PO4	3	3	3	3
PO5	2	2	2	2

BSFT226-21: TECHNOLOGY OF MEAT, FISH AND POULTRY (LAB)

Total Marks: 50	L	T	P
	0	0	4

Course objectives:

1. To understand the importance of livestock, egg and poultry industry.
2. To describe structure, composition and nutritional quality of animal products.
3. To illustrate the processing technology and value addition of meat, fish and poultry products.

Course Content

1. Quality evaluation of fish/prawn.
2. Subjective evaluation of Fresh Fish.
3. Cut out examination of canned fish (Sardine, Mackerel, Tuna).
4. Fish product formulation/canning.
5. Estimation of moisture content of meat.
6. Cutout analysis of canned meats/retort pouches.
7. Estimation of protein content of meat.
8. Analysis of frozen meat/meat emulsion products.
9. To study shelf-life of eggs by different methods of preservation.
10. Evaluation of eggs for quality parameters (market eggs, branded eggs).
11. To perform freezing of yolk/albumen.
12. Meat/Egg product formulation.

Course Outcomes:

1. Understand the technology for quality evaluation and formulation of fresh, canned fish.
2. Student shall be well versed with quality parameters of eggs, meat and meat products.
3. Student will be able to understand practical implication of above products.
4. Prepare various value-added products

Mapping of Course Outcomes with Program Outcomes:

CO / PO	CO1	CO2	CO3	CO4
PO1	1	1	1	1
PO2	2	1	2	2
PO3	1	1	2	1
PO4	2	1	2	2
PO5	1	1	1	2

BMPD402-18 MENTORING AND PROFESSIONAL DEVELOPMENT

Total Marks: 25	L	T	P
	1	0	0

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A (Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B (Outdoor Activities)

7. Sports/NSS/NCC
8. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department

BSCSEC-104-21 CONFECTIONARY TECHNOLOGY (LAB)

Total Marks: 50(30 Internal + 20 external)	L	T	P
	0	0	2

Course objective: To develop understanding about production, ingredients and equipments involved in confectionary technology.

Course Content

Sugars- Types and sources, methods of preparation of sugars, jaggery, khandsari, raw and refined sugar. Principles of sugar cookery, crystalline and non-crystalline candies.

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.

1. Determine the effect of heat on sugar solution and perform the thread and cold water test.
2. To study the process of inversion, melting and caramelization in sucrose.
3. Preparation of fondant, fudge and brittles.
4. Preparation of *Shakarpara* and *Chhana murki*.
5. Preparation of candy and toffee and to perform quality assessment tests.
6. Preparation of cake decorations.

Recommended Readings:

1. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
2. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
3.Beckette S.T. (2009). Industrial Chocolate Manufacture, Blackwell Publishing Ltd.
4.Minifie B.W. (1999). Chocolate, Cocoa and Confectionary, Aspen Publication.
5. Mohini Sethi, Eram Rao (2011) Food science- Experiments and applications, 2nd ed., CBS publishers &Distributors pvt ltd.

Course outcome

1. Understand about significance and healthy aspects of confectionery and snack food in our daily life.
2. Understand status of confectionery and snack foods industries.
3. Knowledge about the manufacturing of various sugar confections, bakers' confections and snack foods.
4. To know about importance of packaging and quality maintenance of confectionery and snack foods.

Formulation of Course Outcomes-Program Outcomes matrix					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	2	3	2	2
	PO4	1	1	1	1
	PO5	1	1	1	1

BSCGE-201-21 INTRODUCTION TO BIOLOGY

Total Marks: 100	L	T	P
	4	0	0

Course objective: To make students understand the biological concepts related to evolution, life on earth, genetics, living systems.

UNIT I

Biological systems, evolution and biodiversity:

a. Introduction to concepts of biology: Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life

b. Evolutionary history of biological diversity : Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life

c. Classifying the diversity of life : Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

d. Darwinian view of life and origin of species: Darwin's theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation

UNIT II

Biological systems, evolution and biodiversity:

e. Genetic approach to Biology: Patterns of inheritance and question of biology; Variation on Mendel's Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

UNIT III

Chemical context of living systems

a. Chemistry of life: The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

b. Water and life: The water molecule is polar; Properties of water; Ionization of water

UNIT IV

Chemical context of living systems

c. Carbon and life: Organic chemistry-the study of carbon compounds; What makes carbon special? Properties of organic compounds

d. Structure and function of biomolecules

Recommended Readings:

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

Course outcome

1. Understand the basic concepts, principles, and their applications to biological systems.
2. Understand the chemistry of carbon and analyze the potential for biology based on other elements.
3. Understanding about molecular basis of genetic information; genetic variation.
4. To understand structure and function of bio-molecules.

Formulation of Course Outcomes-Program Outcomes matrix

Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	2
	PO2	1	1	1	1
	PO3	1	3	1	2
	PO4	2	1	1	1
	PO5	2	2	1	1

BSCGE-205-21 BIOCHEMISTRY

Total Marks: 100	L	T	P
	4	0	0

Course objective: The Course objective of this course is to provide exposure to the students on cells, structural and functional units of living organisms, and their intricate organization

UNIT I

Biomolecules: Over view of amino acids, proteins and carbohydrates**.**
Lipids- Fatty acids, triacyl glycerols; glycerophospholipids, sphingolipids, sterols.
Nucleic acids- Nucleotides, Nitrogenous Bases- Purines and Pyrimidines; tautomers of bases, nucleotide derivatives, nucleotides as regulating molecules, different types of DNA and RNA

UNIT II

Enzymes Classification- Kinetics and Control: The Michaelis-Menten equation-derivation and physiological significance, the double reciprocal plots, kinetics of multisubstrate reactions, enzyme inhibition, turn over number of enzymes, *Regulatary enzymes*: General properties of allosteric enzymes, theories of allosteric regulation, regulation by covalent modification, kinetics, multienzyme complexes, negative and positive cooperativity, zymogens, isoenzymes, abzymes, ribozymes. *Mechanisms* of enzymes- catalysis, specificity, reactions rate, equilibrium, interaction between an enzymes and substrate, role of binding energy, acid base and covalent catalysis, lock and key & induced fit theories.

Coenzymes: Classifications (metabolite derived/vitamin derived) function of various types , structure of NAD^+, $NADP^+$, FAD & FMN,

Metabolism and Bioenergetics: Principles of bioenergetics-Standard free energy change, experimental measurement of ÎG, ATP and other reaction molecules, metabolic roles of ATP-Phosphoryl group transfer, nuleotidyl group transfer, biological oxidation- reduction reactions. General scheme of studying metabolic pathways, their local and global regulatory agents, energetics, disorders associated with the malfunctioning of pathways.

UNIT III

METABOLIC PATHWAYS
Carbohydrates metabolism: Glycolysis, alcoholic and lactic acid fermentation, pasteur effect, gluconeogenesis, cori-cycle, glucose-alanine cycle, futile cycle. TCA cycle, HMP shunt, glycogenolysis & glycogen synthesis.

Disorders associated with defects in carbohydrate metabolism- a brief account on fructose intolerance, lactose intolerance, lactic acidosis, disorders related to glycogen metabolism, genetic deficiency of Glucose-6-phosphate dehydrogenase, Galactosemia, pentosuria, Diabetes Mellitus (NIDDM and IDDM)

Lipid metabolism: Mobilization of triglycerides, metabolism of glycerol, -*oxidation* of saturated, mono- unsaturated and poly-unsaturated fatty acids, even and odd chain fatty acids. Ketone bodies *Biosynthesis* of fatty acids, fatty acid elongation and desaturation, biosynthesis of triacylglycerols.

Disorders associated with defects in Lipid metabolism: Refsum's disease, Gaucher's disease, Niemann Pick's disease, Tay Sach's disease

UNIT IV

Metabolism of amino acids: Assimilation of Ammonia: its incorporation in glutamate, glutamine and alanine as nitrogen carrier, regulation of glutamate dehydrogenase and glutamine synthetase, transamination reactions-role of pyridoxal phosphate, nitrogen excretion and *urea cycle*. *An overview of* degradation pathways of amino acids with detailed pathway

of phenylalanine and branched chain amino acids.

Disorders associated with defects in protein and amino acid metabolism: disorder associated with deficiency of Urea cycle enzymes, Phenylketonuria, Alcaptonuria, Maple syrup urine disease, tyrosinemia

Metabolism of Nucleotides: Brief outline of *Denovo* systhesis of purines and pyrimidines, salvage pathway, reduction of ribonucleotides to deoxyribonucleotides, degradation of purines and pyrimidines, nucleotide analogs as chemotherapeutic agents.

Disorders associated with defects in nucleotide metabolism- Gout, Lesch Nyhan Syndrome, SCID, Orotic aciduria.

Electron-transport chain (ETC) and oxidative phosphorylation: Constituents of ETC & their sequence (Complex I-IV) & location, inhibitors of ETC, chemiosmotic theory, ATP synthase complex- structure and function, dicarboxylic acid shuttle, glycerol phosphate shuttle, P:O ratio, regulation of oxidative phosphorylation.

Recommended Readings:

1. Lehningers Principles of Biochemistry by David L. Nelson and Michel M. Cox. Publisher: WH Freeman; Edition V..
2. Biochemistry by Lubert Stryer. Publisher:WH Freeman; Edition VI.
3. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. Publisher: McGraw Hill; Edition 28.
4. Biochemistry by Donald Voet and Judith Voet. Publisher: John Wiley and sons; Edition: II
5. Biochemistry by Mary K.Campbell & Shawn O.Farrell. Publisher: Cenage Learning. Edition

Course outcome

1. Understand the fundamental energetics of biochemical processes, chemical logic of metabolic pathways
2. Understanding about structure, functions and the mechanism of action of enzymes. Learning kinetics of enzyme catalyzed reactions and enzyme inhibitions and regulatory process. Exposure of wide application of enzymes.
3. Understanding about metabolic pathways – carbohydrate metabolism, lipid metabolism, metabolism of amino acids, and metabolism of nucleotides.
4. Understanding about the structure and properties of nucleic acids

Formulation of Course Outcomes-Program Outcomes matrix .					
Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	2	2	1
	PO2	1	2	1	2
	PO3	1	1	1	2
	PO4	1	3	2	1
	PO5	1	3	1	1

BSCGE-206-21 BIOCHEMISTRY (LAB)

Total Marks: 50

L	T	P
0	0	4

Course objective: The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis

Course Content

1. Separation of biomolecules by electrophoresis.
2. Qualitative analysis of sugars.
3. To study the principle of spectrophotometer and verify Beer's law.
4. Quantitative estimation of DNA/RNA.
5. Quantitative estimation of protein using spectrophotometer.
6. To plot absorption spectrum of DNA and protein and find lmax.
7. To perform biochemical assay of an enzyme under optimal conditions.
8 To study the effect of pH/temperature/heavy metals/ on the activity of enzymes (any one factor).
9. To determine Km and Vmax of an enzyme.
10. Case studies related to metabolic disorders
Gierke's/Galactosemia, Phenylketonuria

Course outcome

1. Understand the principles of various fields of chemistry and biology (organic chemistry, analytical chemistry, biochemistry, genetics, metabolism, and molecular biology).
2. Understanding fundamental principles behind electrophoresis and apply them practically.
3. Quantitative determination of sugars
4. Understanding instrumentation and applications of spectroscopy, chromatography and sedimentation techniques.

Formulation of Course Outcomes-Program Outcomes matrix .

Program Outcome (PO)	Course Outcome (CO)				
		CO1	CO2	CO3	CO4
	PO1	1	1	2	1
	PO2	1	1	1	1
	PO3	1	1	1	1
	PO4	2	2	2	1
	PO5	1	1	1	1