1.1.3

Supporting Documents-

Department of Food Science & Technology

Syllabus of Courses Highlighting the Focus on Employability/Entrepreneurship/Skill Development

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.

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

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.

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.

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.

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

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.

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).

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.

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.

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

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

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.*

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.

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:

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

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.

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

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.

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.

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.

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 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	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

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

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

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 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	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

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 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	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

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

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.

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*

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.

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.

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.

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

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.

IK Gujral Punjab Technical University
M. Tech of Food Technology (Batch 2018)

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.

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

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