

## Supporting Documents-

1.1.3 & 1.2.1

Name of the Department: Food Science and Technology

**Syllabus of courses highlighting the focus on employability / entrepreneurship / skill**





**PFNB-106 LABORATORY-I**

Internal Marks	External Marks	Total Marks	Credits
40	60	100	2

L	T	P
-	-	4

**LIST OF EXPERIMENTS**

1. Preparation of standard solution.
2. Carbohydrates: qualitative tests, estimation of reducing/non-reducing sugars, total sugars, starch and polarimetry of sugars.
3. Lipid extraction and its evaluation. Solvent extraction method, PV, saponification, iodine value, acid value, free fatty acid.
4. Protein estimation.
5. Mineral Estimation.
6. Crude fiber estimation.
7. Determination of moisture content by
  - a. loss on drying (using oven and vacuum oven).
  - b. Moisture meter.
  - c. Distillation.
7. Estimation of total phenolic content of biomaterial.
8. Estimation of total flavonoids content of biomaterial.
9. Estimation of total antioxidant activity of biomaterial.
10. Estimation of FRAP (Ferric reducing antioxidant activity) assay or reducing power.
11. Estimation of hydrogen peroxide ( $H_2O_2$ ) scavenging activity.
12. Estimation of Free radical scavenging activity on DPPH: ( $\alpha$ ,  $\alpha$ -diphenyl - $\beta$  - picrylhydrazyl).
13. Organoleptic evaluation of food materials.
14. Objective evaluation of food materials. water activity, viscosity, texture analysis, color.

**Reference Books**

- Brain S. Furniss, A.J.Hannaford; *Vogel's Text Book of Practical Organic Chemistry*,
- John Wiley & sons; *P.W.G. Smith. A.R. Tatchell, 5<sup>th</sup> Edition, Inc. New York, 1989.*
- Skoog and West; *Instrumental Methods of Analysis*..
- C.K. Kokate, VallabhPrakashan; *Practical Pharmacognosy*., New Delhi.
- K.R., NiraliPrakashan, *Practical Pharmacognosy*: Khandewal, Pune.

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## PFNB-203 ADVANCES IN PHYTOCHEMICAL ANALYTICAL TECHNIQUES

Internal Marks	External Marks	Total Marks	Credits
40	60	100	4

L	T	P
3	1	-

**Objective:** To develop capabilities for performing analysis of phytochemical constituents and subsequent evaluation in nutraceuticals and natural products.

### MODULE 1

(10 hrs)

**INTRODUCTION;** Production Processes for Herbals and Botanicals: Introduction, Cultivation, Collection from the Wild, Pre-preparation Technique (Cleaning, Drying, Packaging of Dried Plants, grinding, peeling etc.); Selection of Plant and Plant Parts for Phytochemical Analysis

**METHODS OF EXTRACTION:** Introduction, Organic Solvent Extraction, Extraction with Supercritical Gases, Steam Distillation, Extraction of Essential Oil, Soxhlet Extractor, Accelerated Solvent Extractor, Purification and Concentration of Miscella, Schemes of procedure for extracting Plant Tissues, Other Minor Extraction Methods, Advances in extraction techniques (Ultrasound extraction, microwave extraction etc).

**QUALITATIVE PHYTOCHEMICAL SCREENING:** Detection of: Alkaloids, carbohydrates and Glycosides, saponins, proteins and Amino Acids, Phytosterols, Fixed Oils and Fats, Phenolic Compounds and Tannins, Gum and Mucilages, Volatile Oil.

### MODULE 2

(14 hrs)

**METHODS FOR SEPARATION OF PHYTOCHEMICALS:** Introduction, Chromatography, Paper Chromatography, Thin layer Chromatography, Column Chromatography (Introduction, Theoretical Principles, overview of instrument, sample handling, interpretation of the produced data).

**QUALITATIVE AND QUANTITATIVE ESTIMATION OF PHYTOCHEMICAL:** Introduction, Gas Chromatography, Liquid Chromatography, High Performance Liquid Chromatography, High Performance Thin layer Chromatography, Optimum Performance Laminar Chromatography (OPLC) (Introduction, Theoretical Principles, overview of instrument, sample handling, interpretation of the produced data).

### MODULE 3

(16 hrs)

**METHODS OF IDENTIFICATION:** Introduction; Physical Characteristics;

Introduction, Theoretical Principles, overview of instrument, sample handling, interpretation of the produced data – Spectroscopy; Ultra Violet Spectroscopy; Infrared Absorption Spectroscopy; Near-Infrared Absorption Spectroscopy; Mass Spectroscopy; Nuclear Magnetic Resonance Spectroscopy; CHN Analysis; x-Ray Crystallography .

### MODULE 4

(8 hrs)

**CATEGORIES OF PHYTOCHEMICALS OVERVIEW OF DIFFERENT PHYTOCHEMICALS:** Introduction, Terpenoids, Steroids, Phenolic Compounds, Alkaloids, Glycosides, Carbohydrates, Lipids and Related Compounds, Plant Pigments, Vitamins, Amino Acids, Proteins, Nucleic Acids.

**TOXIC RESIDUE DETERMINATION:** Pesticide residue, Arsenic and Heavy Metals

#### Reference Books:

- By Prof N Raman; *Phytochemical Techniques*, , New India Publishing Agency.
- By Veronika R. Meyer, *Practical High- Performance Liquid Chromatography*; John Wiley & sons.
- By W. Jeffery Hurst; *Methods of Analysis for Funtional Foods & Nutraceuticals*, CRC Press.



**PFNB – 204 FUNCTIONAL FOOD & NUTRACEUTICAL: DESIGN & DEVELOPMENT**

Internal Marks	External Marks	Total Marks	Credits
40	60	100	4

L	T	P
3	1	-

**Objective:** To develop capability for devising research problem in the area of interest.

**MODULE 1****(10 hrs)**

Introduction – design & development, Project- Meaning, Characteristics, levels, classification, aspects – Preliminary & Feasibility and approach, Project cycle, Project Analysis. Product Design & development – Concept, Factor affecting development of a new product, People involved in Product Design and development, Product Life cycle

**MODULE 2****(14 hrs)**

The Process of product development- product strategy, Idea/Concept Generation, feasibility/Optimization, product design and process development, pre-launch, product commercialization, product launch and evaluation. Role of consumers research & market research in product development, Requirements for development of food products vs. functional food/nutritional products, Steps to bring Functional foods on the market. The knowledge base for product development technology - knowledge and the food system, knowledge management, knowledge for conversion of product concept to new product, technological knowledge (product qualities, raw material properties, processing, packaging requirement, distribution and marketing.

**MODULE 3****(12 hrs)**

Structural Design Principles for improved Food Performance & Processing technology approaches to produce encapsulation and delivery systems – Emulsion, spray drying, freeze drying, co-extrusion, microencapsulation and Nano-laminated Biopolymer Structures in Foods; The shelf life of foods. Reverse pharmacology for developing functional foods/herbal supplements. New trends for food product design & case studies.

**MODULE 4****(12 hrs)**

Natural Products Drug Discovery: Introduction, the current pharmaceutical Scenario, why Natural products are intrinsically useful for drug discovery, possible reasons for the current downsizing of natural product drug discovery, Strategies in natural product drug discovery; Ayurveda in modern medicine- development and modification of bioactivity. Case study of Cancer Drug Discovery and Development

**Reference Books:**

- Clarke & Wright W. 1999; *Managing New Product and Process Development*; Free Press.
- Earle and Earle 2001; *Creating New Foods*, Chadwick House Group.
- Earle R & Anderson A. 2001; *Food Product Development* Earle R, Woodhead Publications.
- Fuller 2004; *New Food Product Development - from Concept to Market Place*, CRC.
- Nissim Garti and D. Julian McClements; *Encapsulation technologies and delivery systems for food ingredients and nutraceuticals*; Woodhead Publishing Ltd.
- D. Julian McClements and Eric A. Decker, *Designing functional foods*; Woodhead Publishing Ltd.
- Jim Smith and Edward, *Functional Food Product Development*; Blackwell Publishing Ltd

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**PFNB – 205 QUALITY & SAFETY STANDARDS & REGULATION AFFAIRS**

Internal Marks	External Marks	Total Marks	Credits
40	60	100	4

L	T	P
3	1	-

**Objective:** To develop the capability for ensuring regulatory obligations in the area of interest nationally as well as internationally

**MODULE 1****(12 hrs)**

Introduction quality control & quality assurance; Statistical approaches in quality control and quality assurance; Production planning and Control  
WTO, GATT, GATS, Codex Alimentarius Commission, Requirement of good manufacturing practices (GMP), good hygienic process (GHP), Cleaning and disinfection Principles.

**MODULE 2****(10 hrs)**

Hazard Analysis Critical Control Point (HACCP) and its implication ISO – 22000:2005, Food safety and standards act – 2006, British Retail consortium, Safe quality food.  
AGMARK- 1937, FPO 1955, PFA –1954, BIS –1952, consumer protection act –1986, Vanaspati control order –1978, export quality control and inspection act- 1963, Green Label certification, Organic food certifications, Certifications for GMFs.

**MODULE 3****(12 hrs)**

ISO-9000 series (2008), Concept of total quality control (TQM), ISO- 19011, GLP, ISO-17025.  
Functional foods associated health claims for consumer: Introduction, EU legislation, U.S. regulation, Japan, Asia, Australia, New Zealand and other countries regulations on nutrition, health and related claims made on functional foods & their support, regulatory Issues/challenges for herbal medicinal plants. Harmonisation of regulations, DSHEA.

**MODULE 4****(14 hrs)**

Materia-medica. Ayurvedic Pharmacopoeia of India (API), United States Pharmacopoeia (USP), European Pharmacopoeia (EP), European evaluation agency (EMA), Drug and cosmetic Act. ICMR,, ESCOP, ICH, FDA, WHO, GCLP.  
Industrial legislation and laws, acts and disputes. Industrial disputes act –1947, Intellectual Property: concept and fundamental- Patent Laws, copy right, trade mark and IPR governing discovery and development of drugs from natural sources, IPP, WIPO (World Intellectual Property Organization), TRIPS, Trade Related Investment Measures (TRIMS), Biopiracy of Medicinal plants;

**Reference Books:**

- By Mike Dillon & Chris Griffith; *Auditing in the Food Industry*; CRC Press
- By Norman G. Marriott ; *Essentials of Food Sanitation*
- By Michael M. Cramer; *Food Plant Sanitation (Design, Maintenance & Good Manufacturing Practices)*, CRC Press
- By Inteaz Alli; *Food Quality Assurance Principles & Practices*, CRC Press
- By Sandy Weinberg; *Good Laboratory Practice Regulations Drugs & Pharmaceutical Sciences*, CRC Press
- By Sidney H. Willing, Marcel Dekkerine; *Good Manufacturing Practices for Pharmaceutical (A Plan for Total Quality control from Manufacturer to Consumer)*.



**PFNB – 301 RESEARCH METHODOLOGY**

Internal Marks	External Marks	Total Marks	Credits
40	60	100	4

L	T	P
3	1	-

**Objective:** Basic understanding of research concepts and its methodologies. After completion of this course, student will be enabled to select and define appropriate research problem, prepare project proposal and to write research report and thesis.

**MODULE 1****(8 hrs)**

**INTRODUCTION:** 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 2****(14 hrs)**

Meaning, nature and types of data: primary and secondary; observational; experimental. Data Collection: types of sampling design. Principles of research design and methodology, general types of research designs and approaches. Experimental designs, quasi-experimental designs, non-experimental or qualitative designs, designing a questionnaire, method of survey, epidemiological studies. General approaches for controlling artifact and bias: validity, sources of artifact, bias and their control (randomization and blinding).

**DATA ANALYSIS:** statistics-concept and types, descriptive and inferential, parametric and non-parametric, stochastic and deterministic. Tools of descriptive statistics and their application. Central tendency, dispersion, measures of association, correlation and regression

**MODULE 3****(18 hrs)**

Concept of probability, probability distribution, normal distribution, poisson distribution. Hypothesis testing and level of significance. Paired and unpaired t-test, Chi-square, F-test, ANOVA: one way and two way, Tukey's HSD, interpreting data and drawing inferences. Multiple correlation and regression, index number.

Non-parametric tests: sign test; Mc Nemer test, Mann-Whitney test, Kruskal-Wallis test, Spearman's rank correlation, principal component analysis.

**MODULE 4****(8hrs)**

Ethical considerations in research; disseminating research result & distilling principles of research design and methodology: sharing the result of research studies, presentation of result. Research report: need of research report, overall structure of research report, tips on writing specific sections. Types of publication. Writing review and research papers: overall structure of review and research report, general guidelines

**Reference Books**

- Luciene TM Blessing and Amaresh Chakrabarti; *DRM, a design research methodology.. Springer.*
- Yogesh Kumar Singh; *Fundamental of Research Methodology and Statistics. New Age International (P) Limited, Publishers.*
- Geoffrey Marcyk, David DeMatteo, David Festinger; *Essential of Research Design and Methodology. John Wiley & Sons*
- Kothari, C.R; *Research Methodology: Methods and Techniques.. New Age International Publishers, New Delhi.*
- Arya. P.P. and Pal; *Research Methodology in Management: Theory and case Studies. Y. Deep and Deep Publishers Pvt. Ltd., New Delhi*



### THIRD SEMESTER

Course Code	Course Title	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
PFNB-301	Research Methodology	3	1	-	40	60	100	4
PFNB-302	Elective –I	3	1	-	40	60	100	4
PFNB-303	Elective –II	3	1	-	40	60	100	4
PFNB-304	Seminar	-	-	2	40	60	100	2
PFNB-305	Dissertation (Part-I)	-	-	8	Satisfactory/ Un-Satisfactory			8
TOTAL		9	3	10	160	240	400	22

### FOURTH SEMESTER

Course Code	Course Title	Load Allocation			Marks Distribution	Credits
		L	T	P		
PFNB-401	Dissertation (Part –II)	-	-	22	Satisfactory/ Un-Satisfactory	22**

\* Not to be shown in DMC

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

Terminology: L means Lecture, T means Tutorial, P means Practical, MST means Mid Semester Test, DMC means Detailed Marks Certificate

Credit System: 01 Credit for 01 Lecture / Tutorial / Seminar / Dissertation hour per week.

01 Credit for 02 Practical hour per week

#### Elective-I

Sr No.	Subject
1.	Modelling & Simulation
2.	Energy Management in Processing Industry
3.	Unit Operations
4.	Genetic Engineering

#### Elective-II

Sr No.	Subject
1.	Processing of Plant Bioactive
2.	Processing of Animal Bioactive
3.	Preservation and Packaging Technology
4.	Nutraceutical Discovery Process

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## Study Scheme

Course Code	Course Type	Course Name	Load			Marks			Credits
			L	T	P	Internal	External	Total	
PHP-101	Compulsory Course	Research Methodology	3	1	-	30	70	100	4
PHP-201	Core Theory (Any One)	Pharmaceutics	3	1	-	30	70	100	4
PHP-202		Pharmaceutical Chemistry	3	1	-	30	70	100	
PHP-203		Pharmacology	3	1	-	30	70	100	
PHP-204		Pharmacognosy	3	1	-	30	70	100	
PHP-301	Interdisciplinary Course (Any One)	Modern Pharmaceutical Analytical Techniques	3	1	-	30	70	100	4
PHP-302		Intellectual Property Rights	3	1	-	30	70	100	
PHP-303		Pharmacology & Toxicological Screening Methods	3	1	-	30	70	100	
PHP-304		Biochemical & Separation Techniques	3	1	-	30	70	100	
PHP-305		Bioprocess Technology	3	1	-	30	70	100	
PHP-306		Recombinant Biotechnology	3	1	-	30	70	100	
PHP-307		Plant Tissue Culture	3	1	-	30	70	100	
PHP-401	Presentation	*Presentation	-	-	6	75	-	75	3
Total			09	03	06	165	210	375	15

\*Minimum three presentations related to proposed research area of the candidate

\*Non-University Exam

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
PHP-101	Research Methodology	3	1	-	30	70	1.5	3	4

### Overview of Research

10 Hrs

Research and its type, identifying and defining research problems, introduction to different types of research designs. Essential constituents of literature review. Basic principles of experimental design, completely randomized, randomized block, Latin square, factorial

### Methods of Data Collection

04 Hrs

Primary and secondary data, methods of primary data collection, classification of secondary data

### Sampling Methods

10 Hrs

Probability sampling: simple random sample, systematic sampling, stratified sampling, cluster sampling and multistage sampling; Non-probability sampling: convenience sampling, judgement sampling, quota sampling; sampling distribution

### Processing and Data Analysis

15 Hrs

Statistical measures and their significance: central tendencies, measures of variability, skewness, kurtosis, correlation and regression; hypothesis testing: parametric test (z, t, F), Chi square, ANOVA and non-parametric test

### Reliability and Validity

03 Hrs

Test- retest reliability, alternative form reliability, internal-comparison reliability, and scorer reliability; content validity, criterion- related validity and construct validity

### Essentials of Report Writing

05 Hrs

### Suggested Readings/Recommended Books (Latest Editions)

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

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## MSFT-513- 18: 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, Prokaryotes 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 Westhoff, 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* (5<sup>th</sup> ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5<sup>th</sup> ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applications*. Prentice Hall, New Jersey.
6. Frazier, W. C. & Westhoff, D. C. (1995). *Food Microbiology* (4<sup>th</sup> 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.

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

**Mapping of Course Outcomes with Program Outcomes:**

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

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**MSFT-514- 18: FOOD PROCESSING & PRESERVATION**

Total Marks: 100

L	T	P
4	0	0

**Objective:**

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

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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

**UNIT-IV**

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

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

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

**Recommended readings:**

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



**Course Outcomes:**

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

**Mapping of Course Outcomes with Program Outcomes:**

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

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**MSFT-515- 18: 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.

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**Mapping of Course Outcomes with Program Outcomes:**

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

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**MSFT-516- 18: 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

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## MSFT-521- 18: DAIRY TECHNOLOGY

Total Marks: 100

L	T	P
4	0	0

### Objective:

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

### UNIT-I

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

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

### UNIT-II

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

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

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

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

### UNIT-III

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

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

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

### UNIT-IV

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

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

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



**Recommended readings:**

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

**Course Outcomes:**

Students shall acquire knowledge about

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

**Mapping of Course Outcomes with Program Outcomes:**

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

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**MSFT-524- 18: 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.

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**Mapping of Course Outcomes with Program Outcomes:**

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

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## MSFT-525- 18: 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 spectrophotometry, flame photometry/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

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**MSFT-526- 18: 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

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## MSFT-529- 18: 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

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### MSFT-530- 18: 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 debittering 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

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

**Course Outcomes:**

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

**Mapping of Course Outcomes with Program Outcomes:**

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

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## MSFT-612- 18: 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, objectives and scope of food standards and quality assurance, including role of various national and international agencies. Total quality management- general awareness and role of management practices in quality control, concept of HACCP and ISO series and their importance. Plant/food industry sanitation, maintenance sanitary conditions and hygienic practices.

### UNIT-II

Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Food inspection and safety measurements, food regulations and grades. Statistical analysis in quality control-sampling design of experiments and evaluation of results.

### UNIT-III

Methods of sensory evaluation, introduction to sensory analysis. Sensory evaluation techniques for fresh fruits and vegetable procured products. Food testing- hedonic test, general acceptability tests and other desirable ranking tests of sensory evaluation of flavour, aroma, taste, texture, and overall acceptability of food products.

### UNIT-IV

Various food standards and their regulating agencies. Methods of quality analysis: Moisture, proteins, carbohydrates, minerals, vitamins, fats, crude fibres and related substances. Raw material and finished products quality assurance- cereals, legumes, oil seeds, fruits and vegetables, laboratory methods for quality control.

### Recommended readings:

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

### Course Outcomes:

1. To create understanding of quality control and assurance system in food industry.
2. To understand the risk assessments procedure for food sector.
3. GMPs and GHP regulations in the food sector.
4. To understand the different food safety management used worldwide.
5. To understand the sensory evaluation methodology used in food industry.

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**Mapping of Course Outcomes with Program Outcomes:**

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

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## MSFT-614- 18: 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

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### MSFT-617- 18: LAB - IX (Food Additives)

Total Marks: 50

L	T	P
0	0	4

#### Objectives:

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

#### List of experiments:

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

#### Course Outcomes:

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

#### Mapping of Course Outcomes with Program Outcomes:

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

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### MSFT-618- 18: 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 Spectrophotometric 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

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### Semester Third

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
MSFT-611- 18	Technology of Cereals, Pulses & oilseeds	4	-	-	30	70	100	4
MSFT-612- 18	Food Safety, Standards & Quality Control	4	-	-	30	70	100	4
MSFT-613- 18	Agri Business Management	2	-	-	30	20	50	2
MSFT-614- 18	Lab - VIII (Technology of Cereals, Pulses & oilseeds)	-	-	4	35	15	50	2
MSFT-615- 18- 616- 18	Programme Elective-II	4	-	-	30	70	100	4
MSFT-617- 18- 618- 18	Programme Elective-II (Lab)	-	-	4	35	15	50	2
MSFT-619- 18	In-Plant Training	-	-	12		150	150	6
MSFT-630- 18	Seminar	-	-	2	30	20	50	1
	<b>Total</b>	<b>14</b>	<b>-</b>	<b>22</b>	<b>220</b>	<b>430</b>	<b>650</b>	<b>25</b>

#### Programme Elective-II \*\*

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

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

### Semester Fourth

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
MSFT-621- 18	Snack Food Technology	4	-	-	30	70	100	4
MSFT-622- 18- 623- 18	Programme Elective-III	4	-	-	30	70	100	4
MSFT-624- 18	Dissertation	-	-	24	Satisfactory/Unsatisfactory			12***
	<b>Total</b>	<b>8</b>	<b>-</b>	<b>24</b>	<b>60</b>	<b>140</b>	<b>200</b>	<b>20</b>

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

#### Programme Elective-III for Fourth Semester \*\*\*\*

Course Code	Course Title	Load Allocation			Marks Distribution		Total	Credits
		L	T	P	Internal	External		
MSFT-622- 18	Food Biotechnology	4	-	-	30	70	100	4
MSFT-623- 18	Technology of Meat, Fish and Poultry	4	-	-	30	70	100	4

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

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**Important Notes: -**

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

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**MTFT-521-18: ADVANCED FOOD PROCESS TECHNOLOGY**

Total Marks: 100

L	T	P
4	0	0

**Objectives:**

1. To acquire knowledge of emerging / alternative technologies applied to food processing.
2. To enable a student to know the relative advantages / disadvantages over existing technologies.
3. To understand the economics and commercialization of newer technologies.
4. To study about microbial safety of foods by emerging methods.

**Course Outcome:** On completion of the subject, the students will be able to:

1. Develop an appreciation about need of different emerging techniques used in food processing and preservation.
2. Apply their knowledge on high pressure processing, pulsed electric processing, irradiation and hurdle technology in various food industries.
3. Understand the concepts related to membrane technology, supercritical fluid extraction and quality assessment of food using ultrasonic techniques.
4. Get an overview on principles, mechanism and application of nanotechnology in food.

**Course Content:**

**UNIT-I**

Membrane Technology: Introduction to pressure activated membrane processes, RO/UF/NF applications and technology, Food Irradiation: radiation sources, absorbed dose, regulations, advantage and limitations of food irradiation - nutritional and microbiological changes in irradiated foods.

**UNIT-II**

Supercritical Fluid Extraction: Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment and experimental techniques used in NCF extraction and industrial application, Microwave Energy in Foods: working principle of magnetron, microwave blanching, sterilization and finish drying, Ohmic and Ultrasound Processing of Foods: Principle of ultrasound – fundamentals – ultrasound as a processing and preservation method–Effect on properties of foods, Properties and generation of ultrasonic, ultrasonic imaging, application of ultrasonic as an analytical tool and processing techniques, Basics of ohmic heating, electrical conductivity- generic configurations-treatment of products.

**UNIT-III**

High Pressure Processing of Foods: Principles and concept – applications to food systems effect on quality, textural, Nutritional and microbiological quality – factors affecting the quality, applications in food processing, Pulsed Electric field Processing of Food(PEF): Principles Mechanism of action-PEF treatment systems, main processing parameters – PEF Technology – equipments – mechanism of microbial and enzyme inactivation- safety aspects– processing of liquid foods using PEF –process models – comparison of high pressure processing and PEF –Enzymatic inactivation by PEF, examples – microbiological and chemical safety of PEF foods, Oscillating magnetic field.

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**UNIT-IV**

Hurdle Technology: Concept, chemical and biochemical hurdles- organic acids-plant derived antimicrobials, Antimicrobial enzymes, bacteriocin, applications of hurdle technology, Advanced Techniques in Food Processing: Application of technologies of high intensity light, Nanotechnology: Principles and mechanism Radio-frequency heating and drying applications; Hybrid drying technologies- combined microwave vacuum drying, combining microwave vacuum drying with other processes.

**Recommended Readings:**

1. Sun, Da-Wen (2005). *Emerging Technologies for Food Processing*: Academic Press.
2. Barbosa- Canovas, G. V., Tapia, M. S. and Cano, M. P. (2004). *Novel Food Processing Technologies*: CRC Press.
3. Leistner L. and Gould G. (2002). *Hurdle Technologies –Combination Treatments for Food Stability, Safety and Quality*: Kluwer Academics /Plenum Publishers, New York.

**Mapping of course “Advanced Food Process Technology- MTFT-521-18” outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	3	2	1	3	2	2
	CO 2	3	2	2	3	1	1
	CO 3	3	2	2	3	1	1
	CO 4	2	2	2	2	1	1

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**MTFT-524-18: Lab-IV (CEREAL SCIENCE AND TECHNOLOGY)**

Total Marks: 50

L	T	P
0	0	4

**Objective:**

1. To learn the techniques to assess the quality of cereal grains and processed food products.
2. To illustrate the dough rheological properties.

**Course Outcome:** On successful completion of the subject, the students will be able to:

1. Understand the recent methods of quality assessment of raw materials.
2. Knowledge about rheological characterization of dough through advanced rheological instruments.
3. Aware of role of ingredients and processing parameters on processed products.
4. Understand methods to evaluate the processed food quality.

**Course Content:**

Grading of wheat varieties, milling quality of hard and soft wheat varieties, effect of conditioning on the flour extraction rates, effect of grains parameters on the flour yield and quality, quality assessment of wheat gluten, damaged starch and bread flour quality, effect of damaged starch of flour on biscuit quality, factors affecting water absorption of wheat flour, effect of ingredients and processing parameters of yeast growth, assessment of dough rheology using doughLab and mixolab, bread, biscuits, noodles making potential of different wheat flours, quality assessment of bakery products.

**Mapping of course "Lab-IV (Cereal Science and Technology)- MTFT-524-18" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	1	2
	CO 2	2	3	1	3	2	1
	CO 3	1	2	2	3	2	2
	CO 4	2	2	2	2	2	1

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**MTFT-525-18: Lab-V (NOVEL FOOD PACKAGING)**

Total Marks: 50

L	T	P
0	0	4

**Objective:**

1. To provide practical knowledge of various recent techniques
2. To illustrate fundamental understanding of food packaging techniques used in industries.

**Course Outcome:** On successful completion of the subject, the students will be able to:

1. Understand different types of food packaging materials.
2. Aware of symbols used in food industries.
3. Understand the role and effectiveness of various packaging systems.
4. Shelf life evaluation of packaged foods.

**Course Content:**

Testing of properties of different packaging materials (paper, plastic, glass and metal), study of symbols and labels used on food packages, vacuum packaging, form-fill- seal packaging, determination of changes in packaged foods, packaging of foods under different conditions, preparation and application of edible coatings, comparative evaluation of different packages for fragile foods, estimation of shelf life of food under different packaging materials.

**Mapping of course "Lab-V (Food Packaging)- MTFT-525-18" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
	CO 1	1	2	2	3	1	2
Course Outcome (CO)	CO 2	1	1	1	2	2	2
	CO 3	1	2	2	2	2	2
	CO 4	2	1	2	2	2	1

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MTFT-531-18: Lab-VI (FROZEN FOOD TECHNOLOGY)

Total Marks: 50

L	T	P
0	0	4

**Objectives:**

1. To determine effective cooling and freezing time.
2. To evaluate frozen food quality and their shelf life.
3. To standardize methods for preparation of frozen vegetables.
4. To understand suitability of different packaging materials for packing of frozen foods.

**Course Outcome:** On completion of the subject, the students will be able to apply their knowledge on:

1. Cold storage of perishable products and their quality evaluation.
2. Calculating freezing load and freezing time for different foods.
3. Determination of mineral impurities in frozen food.
4. Packaging of frozen food and their shelf life evaluation.

**Course Content:**

Determination of effective freezing time, cooling and half cooling time, Quality evaluation of frozen foods, mechanism and driving force for freezer burn, adequacy of thawing, Demonstration of components of a refrigerator, Standardization of procedure for preparation of frozen peas and corn, Frozen food packaging and shelf-life evaluation, Tests of adequacy of blanching of raw material before freezing, Mineral impurities in frozen vegetables, Color grading of fresh and frozen fruit juices, Packaging of frozen food.

**Mapping of course "Lab-VI (Frozen Food Technology)- MTFT-531-18" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
Course Outcome (CO)	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
	CO 1	2	2	2	3	2	1
	CO 2	3	2	2	3	1	2
	CO 3	2	2	2	2	1	2
	CO 4	2	2	2	3	2	2

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**MTFT-612-18: Lab-VII (MILK AND MILK PRODUCTS QUALITY)**

Total Marks: 50

L	T	P
0	0	4

**Objective:**

1. To exemplify the quality of milk and milk products.
2. To depict the detection of adulterants in milk.
3. To demonstrate the manufacturing various dairy products.
4. To illustrate the quality of dairy products.

**Course Outcome:** After the completion of the course, the students will be able to:

1. Understand different methods of milk quality analysis.
2. Grasp the detection methods of adulterants in milk.
3. Apprehend the manufacturing of different dairy products.
4. Perceive the quality analysis of dairy products.

**Course Content:**

Analysis of milk: total solids, fat, SNF, protein, lactose, acidity, ash, total bacterial count, analysis of adulteration of milk (sugar, carbohydrate, urea, neutralizer, water), turbidity test for sterilized milk, preparation of sterilized flavoured milk, Cream preparation, preparation of ghee from cream/ butter, FFA value of ghee, preparation of ice-cream, overrun of ice cream (by weight/by volume), preparation of cheddar/gouda/mozzarella cheese, moisture of milk powder, bulk/true density of milk powder, solubility of milk powder, preparation of prebiotic yoghurt/ dahi, compositional analysis of traditional dairy products, manufacturing of sodium caseinate/calcium caseinate.

**Mapping of course "Lab-VII (Milk and Milk Products Quality)- MTFT-612-18" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
Course Outcome (CO)	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
	CO 1	1	2	2	3	2	3
	CO 2	2	2	2	3	2	2
	CO 3	1	2	1	3	2	2
	CO 4	2	2	2	3	2	2

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**MTFT-617-18: ADVANCED MEAT, FISH, POULTRY AND EGG TECHNOLOGY**

Total Marks: 100

L	T	P
4	0	0

**Objective:**

1. To understand the importance of livestock, egg and poultry industry.
2. To describe structure, composition and nutritional quality of animal products.
3. To comprehend the various post-mortem changes related to muscle and various other tissues.
4. To illustrate the processing technology of meat, poultry, fish and eggs.
5. To explain value addition and packaging of meat, fish and poultry products.

**Course Outcome:** After the completion of the course, the students will be able to:

1. Understand the technology for raw material characteristics, handling, processing, and preservation.
2. Grasp by-product utilization of meat, poultry, fish and egg products.
3. Apprehend the hygiene, sanitation and mechanized practices of meat, fish, poultry and egg industry.
4. Comprehend the food standards in relation to these food commodities.
5. Perceive the knowledge regarding transportation and storage practices.
6. Prepare various value added products.

**Course Content:**

**UNIT-I**

Production, Processing and consumption trends, Prospects of meat industry, Meat spoilage, Endogenous and exogenous infections, Hygiene and sanitation, Meat composition from different sources, Post-mortem muscle chemistry and composition, Intramuscular fat, Rigor mortis, The conversion of muscle into meat: Animals' stunning methods, ante-mortem and post-mortem examination, Design of handling facilities: Slaughtering and dressing, Consequences of circulatory failure, Proteolytic and other chemical changes, Operational factors affecting meat quality, Effects of processing on meat tenderization, Chilling, freezing and preservation, prepared meat products, intermediate moisture and dried meat products, The eating quality of meat: color, flavors and retention, water holding capacity, juiciness, texture and taste, meat eating and health, Inedible by-products.

**UNIT-II**

Quality characteristics of poultry products, Lay-out and design of poultry processing plants, Plant sanitation, Poultry meat processing operations and equipment for de-feathering, bleeding, scalding etc., Poultry meat products, Refrigerated storage of poultry meat, by-products

**UNIT-III**

Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage, eating quality of eggs, Inspection and grading, preservation and safe handling.

**UNIT-IV**

Commercially important marine products from India, Product export and its sustenance, Processing operations, Basic biochemistry, Preservation of postharvest fish freshness, Transportation in refrigerated vehicles, Deodorization of transport systems, Design of refrigerated and insulated trucks,



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Grading and preservation of shell fish, pickling and preparation of fish protein concentrate, fish oil and other by-products

**Recommended Readings:**

1. Lawrie, R. A. (1998). *Lawrie's Meat Science* (6 ed.): Woodhead Publications, Cambridge.
2. Alan, H. V. and Jane, P. S. (1995). *Meat and Meat Products: Technology, Chemistry and Microbiology*: Chapman & Hill, London.
3. Carmen, R. O. and George, J. M. (1997). *Poultry Meat and Egg Production*: CBS Publications, New Delhi.
4. Winton, A. L. and Barberwinton, K. (1999). *Fish and Fish Products*: Agrobios, Bikaner.
5. Winton, A. L. and Winton, K. B. (1993). *The Structure and Composition of Animal Product*: Agro Botanical, Bikaner.

**Mapping of course "Advanced Meat, Fish, Poultry and Egg Technology- MTFT-617-18" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	2	2	2	3	1	2
	CO 2	2	1	2	3	1	2
	CO 3	3	2	2	2	2	2
	CO 4	2	2	2	2	3	2
	CO 5	2	2	2	2	1	2
	CO 6	2	2	1	3	2	2

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**MTFT-618-18: Dissertation-I**

L	T	P
0	0	8

The student is required to prepare his/her research project synopsis and should make a presentation to the DRC before the commencement of the final examination of third semester.

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 104-18	Clinical Research Lab	-	-	4	30	20	3	3	2

**Pre-requisite:** None

**Co- requisite:** Fundamentals of Clinical Research (MSCR102-18)&Pharmacology (MSCR103-18)

**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. Protein estimation by Lowry's method
4. Validation of machines & analytical instruments
5. Extraction of DNA
6. Preparation of SOPs for various equipments
7. To perform liver function test and renal function test
8. Preparation of a Clinical trial protocol for submission to regulatory agency



9. Demonstration of routes of exposure/administration of drugs
10. Demonstration of some non – invasive techniques in preclinical screening of drug
11. Bioethics- do's and don'ts, confidentiality, cultural/social ethics

#### Suggested Readings/Recommended Books (Latest Edition)

1. A.I. Vogel, Text Book of Quantitative Inorganic analysis, Pearson.
2. D Wang and A Bakhai, Clinical Trials A Practical Guide to Design, Analysis, and Reporting, Remedica.
3. D Rosenbaum and M Dresser, Clinical Research Coordinator Handbook, CRC Press.
4. EDeRenzo, Writing Clinical Research Protocols: Ethical Considerations, Academic Press Elsevier.

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 105-18	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 are authentic and are taken 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.

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## Module-II

14 Hrs

### Writing

Topics are of general interest and suitable for candidates planning to work in Clinical Research Organisations. Based on a graph, table, chart or diagram candidates are asked to describe, summarise or explain the information in own words. 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.

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

Write a letter requesting information or explaining a given situation. The letter may be personal, semi-formal or formal in style. Test takers will be asked to write an essay in response to a point of view, argument or problem. Opinions should be supported by relevant examples.

### 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 Heasley. 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

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Course Code	Course Title	Teaching Load			Marks		Exam	Credits
		L	T	P	Int.	Ext.	Internal	
MSCR 106-18 MSCR 206-18 MSCR 307-18	Journal Club	-	-	4	50	-	Continuous Mode	2

**Pre-requisite:** None

**Co- requisite:** Professional Communication (MSCR 105-18), Professional Communication Lab (MSCR 204-18), ICT Skills Lab (MSCR 305-18)

**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

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 203-18	Clinical Research Lab	-	-	4	30	20	1.5	3	2

**Pre-requisite:** Fundamentals of Clinical Research (MSCR102-18)

**Co- requisite:** Clinical Research Regulations (MSCR 202-18)

**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, blood pressure, temperature
2. 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)
3. Application of simple statistical test to the results obtained in above experiments
4. Biochemical tests: total proteins, lipid profile, blood glucose



5. Haematology tests: haemoglobin, total leukocyte count, differential leukocyte count, erythrocyte sedimentation rate
6. Electrocardiography (ECG) recoding
7. Case studies solutions
8. Development of clinical research documents: SOPs development, investigator brochure, informed consent forms, case record form
9. Dummy clinical research and bioequivalence protocols

#### **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

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 204-18	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**

**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

### 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

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 205-18	Medical Writing	2	-	-	15	35	1	2	2

**Pre-requisite:** None

**Co- requisite:** None

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

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

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

**Mapping of course outcomes with the programme outcomes**

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

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### Module-I

12 Hrs

Introduction to medical terminology and fundamentals of medical writing  
Literature survey using books, research journals and other online sources  
Designing and development of clinical research documents i.e. Protocol, Informed Consent Form (ICF), Case Report Form (CRF), Standard Operating Procedure (SOP) on various functional clinical trial procedures

### Module-II

12 Hrs

Patient narrative preparation, abstracts and manuscript  
Writing of clinical study reports  
Educational materials for subjects in clinical research  
Research report and paper writing and plagiarism  
Software relevant to medical writing

### Suggested Readings/ Books

1. Medical Writing: A Guide for Clinicians, Educators, and Researchers Second Edition; Springer 2011,
2. The Complete Guide to Medical Writing by Mark C. Stuart, Mark StuartPharmaceutical Press, 2007,
3. Guidelines for Reporting Health Research by David Moher Douglas Altman BMJ books; August 2014
4. Medical writing a good practice guide by Justina-Orleans; WileyBlackwell 2012

### 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)

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Course Code	Course Title	Teaching Load			Marks		Exam	Credits
		L	T	P	Int.	Ext.	Internal	
MSCR 106-18 MSCR 206-18 MSCR 307-18	Journal Club	-	-	4	50	-	Continuous Mode	2

**Pre-requisite:** None

**Co- requisite:** Professional Communication (MSCR 105-18), Professional Communication Lab (MSCR 204-18), ICT Skills Lab (MSCR 305-18)

**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

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MSC. Clinical Research/Batch2018

Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 212-18	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

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12 Hrs

**Module-I****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

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12 Hrs

**Module-II****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](http://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](http://www.wto.org)

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 213-18	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, Wilcoxin, 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

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 302-18	Clinical Study Design	3	1	-	30	70	1.5	3	4

**Pre-requisite:** Fundamentals of Clinical Research (MSCR102-18)

**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**

Methods of randomization, blinding  
Screening and recruitment of subjects  
Placebo  
Biomarker

**Module-II**

**12 Hrs**

**Type of Studies**

Randomized trial, open label study, double blind, single blind, matched pair study, cross over trial, case control study, cohort study, equivalence trials, superiority trials and non-inferiority



trials

### Module-III

12 Hrs

Trial designs of common diseases like CVS, CNS, cancer and metabolic disorders  
BA-BE study designs

### Module-IV

12 Hrs

Phases of clinical trials  
Designing phase I, II, III and IV trials: Design types, their characteristics, and parameter to measure, endpoints, inclusion and exclusion criteria  
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

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### 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



Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 303-18	Research Methodology	2	-	-	15	35	1	2	2

**Pre-requisite:** None

**Co- requisite:** Clinical Study Design (MSCR 302-18)

**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

CO3 Develop an understanding about different research designs

**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

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## 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 Marcyk, 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

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 305-18	Clinical Research Lab	-	-	4	30	20	1.5	3	2

**Pre-requisite:** Fundamentals of Clinical Research (MSCR102-18) and Clinical Research Regulations (MSCR 202-18)

**Co- requisite:** Clinical Study Design (MSCR302-18)

**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

Pre-requisite: Fundamentals of Clinical Research (MSCR 102-18) and Clinical Research Regulations (MSCR 202-18)	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

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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

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Course Code	Course Title	Teaching Load			Marks		Exam (hrs)		Credits
		L	T	P	Int.	Ext.	Int.	Ext.	
MSCR 306-18	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

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Course Code	Course Title	Teaching Load			Marks		Exam	Credits
		L	T	P	Int.	Ext.	Internal	
MSCR 106-18 MSCR 206-18 MSCR 307-18	Journal Club	-	-	4	50	-	Continuous Mode	2

**Pre-requisite:** None

**Co- requisite:** Professional Communication (MSCR 105-18), Professional Communication Lab (MSCR 204-18), ICT Skills Lab (MSCR 305-18)

**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

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## Fourth Semester

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

### Semester Wise Credits Distribution

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

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

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## First Semester

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

### Discipline Specific Elective Theory (Elective-I)

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

### Generic Elective Theory (Elective-II)

Subject Code	Subject Name
UC-MSCR 113-19	Clinical Pharmacokinetics
UC-MSCR 114-19	Alternatives in Toxicity Testing
UC-MSCR 115-19	Fundamentals of Physiology
UC-MSCR 116-19	Biochemistry & Molecular Biology (SWAYAM/MOOCs)
UC-MSCR 117-19	Soft Skills (SWAYAM/MOOCs)
UC-MSCR 118-19	Neuroscience of Human Movements (SWAYAM/MOOCs)

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**RESEARCH METHODOLOGY AND IPR**

**Teaching Scheme : Lectures: 1hrs/week**

**Course Outcomes:**

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth individuals & nation, it is needless to emphasis the need of information about
6. Model Curriculum of Engineering & Technology PG Courses [Volume-I][ 16 ]
7. Intellectual Property Right to be promoted among students in general & engineering in particular.
8. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

**Course contents**

**Unit I**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**Unit II**

Effective literature studies approaches, analysis Plagiarism, Research ethics,

**Unit III**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**Unit IV**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**Unit V**

: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**Unit VI**



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New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**References:**

- 1 Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
- 2 Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- 3 Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- 4 Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- 5 Mayall, "Industrial Design", McGraw Hill, 1992.
- 6 Niebel, "Product Design", McGraw Hill, 1974.
- 7 Asimov, "Introduction to Design", Prentice Hall, 1962.

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Total Marks: 50

L T P  
0 0 4

**Objectives:**

1. To gain knowledge about the nutraceutical constituents present in various food products.
2. To understand the techniques of analysis plant based nutraceuticals.
3. To prepare and evaluate probiotic foods.
4. To acquire knowledge on estimation and identification of nutraceutical and functional food compounds by various advanced analytical techniques.

**Course Outcome:** On completion of the subject, the students will be able to:

1. Acquire knowledge on various nutraceutical components and their health benefits.
2. Understand various extraction and estimation methods of nutraceuticals.
3. Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
4. Study and demonstrate various aspects regarding safety, quality and toxicology of food products including, nutraceutical and functional foods.

**Course Content:**

Extraction and estimation of nutraceuticals, isoflavones, capsaicinoids, organosulfur cereals and monosaturated fatty acids and lecithins, Isolation and determination of lycopene in tomato and tomato products, Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques, Preparation and evaluations of probiotic foods, Extraction, estimation and identification of nutraceutical and functional food compounds by GLC and HPLC, Study and demonstration of the antimicrobial effects of plant tannins, alkaloids and sulfur compounds, Market survey of existing functional foods, study of labels of existing health foods.

**Mapping of course "Lab-VI (Nutraceuticals and Functional Foods)- MTFT-524b-18" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	3	2	2
	CO 2	2	2	2	3	1	2
	CO 3	3	2	3	3	2	1
	CO 4	2	2	2	2	2	2

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**UC-MTFT-527-19: Lab-VI (ADVANCES IN FOOD ANALYSIS)**

Total Marks: 50

L	T	P
0	0	4

**Objectives:**

1. To demonstrate the applications of current analytical and instrumental techniques.
2. To describe the advanced analytical methods.
3. To illustrate principle and mechanism of analytical instruments.

**Course Outcomes:** After the completion of the course, the students will be able to:

1. Grasp basic preparation of solutions and buffers.
2. Perceive advanced analytical methods.
3. Understand the functioning and principle of various analytical instruments
4. Interpret the spectrophotometric and chromatographic techniques.
5. Comprehend microstructural and DNA isolation techniques.

**Course Content:**

Preparation of solutions and buffers, Determination of titratable acidity in foods using a potentiometric titration, Diastatic activity of honey, UV-Visible Spectro-photometric analysis of a carotenoid, determination of hydroxymethylfurfural in honey, Atomic absorption spectroscopic analysis of heavy metals in foods, Secondary structure analysis of starch and proteins using Fourier Transform Infra-Red (FTIR), Gas chromatography (GC) quantification of alcohol content in beverages using the internal standard method, High performance liquid chromatography (HPLC) quantification of sugars in foods and beverages, Separation and identification of food constituents using HPLC, thin layer chromatography (TLC) of food colors, Microstructural and partial size analysis of starch, Determination of thermal properties of food samples, Extraction of different types of proteins and identification using electrophoresis, DNA isolation and fingerprinting of plant tissues.

**Mapping of course "Lab-I (Advances in Food Analysis)- MTFT-527-19" outcomes and Program outcomes:**

Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)							
	Program Outcome (PO)						
		PO1	PO2	PO3	PO4	PO5	PO6
Course Outcome (CO)	CO 1	1	2	2	2	1	1
	CO 2	2	2	3	3	2	2
	CO 3	3	2	3	3	2	2
	CO 4	3	2	2	3	1	1
	CO 5	3	2	2	3	1	1

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**Semester Second**

Course Code	Course Title	Type	Load Allocation			Marks Distribution		Total Credits	
			L	T	P	Internal	External		
UC-MTFT-521-19	Advanced Food Processing Technology (Theory)	PC	4	0	0	40	60	100	4
UC-MTFT-522-19	Advances in Food Analysis(Theory)	PC	4	0	0	40	60	100	4
UC-MTFT-527-19	Advances in Food Analysis(Lab VI)	PC	0	0	4	30	20	50	2
UC-MTFT-523a-19 or 524a-19	Program Elective-III (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-523b-19 or 524b-19	Program Elective-III (Lab.)	PE	0	0	4	30	20	50	2
UC-MTFT-525b-19 or 526b-19	Program Elective-IV (Lab.)	PE	0	0	4	30	20	50	2
MTAXX-18	Audit course II	PC	2	0	0	Satisfactory/ Un-Satisfactory <sup>#</sup>			Non-credit
UC-MTFT-528-19	Mini project with seminar	PC	0	0	2	30	20	50	2
<b>Total</b>			<b>14</b>	<b>0</b>	<b>14</b>	<b>250</b>	<b>300</b>	<b>550</b>	<b>22</b>

# the concerned teacher will evaluate the students internally (only) as per marks distributions pattern followed for the other subjects/courses.

**Program Elective-III \*\*\***

Course Code	Course Title	Type	Load Allocation			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
UC-MTFT-523a-19	Novel Food Packaging(Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-523b-19	(Novel Food Packaging (Lab-VII)	PE	0	0	4	30	20	50	2
UC-MTFT-524a-19	Nutraceuticals and Functional Foods (Theory)	PE	4	0	0	40	60	100	4
UC-MTFT-524b-19	Nutraceuticals and Functional Food (LabVIII)	PE	0	0	4	30	20	50	2

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

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Course Code	Course Type	Course Title	Load Allocation			Marks Distribution		Total Credits	
			L	T	P	Internal	External		
PHDFT-101-20	Compulsory Course	Research Methodology	3	1	0	40	60	100	4
PHDFT-101-20		Research and Publication Ethics	2	0	0	20	30	50	2
PHDFT-201-20	Core Theory Course (Any one)	Advances in Food Processing Technology	3	1	0	40	60	100	4
PHDFT-202-20		Advances in Food Analysis	3	1	0	40	60	100	
PHDFT-203-20		Advances in Food Packaging	3	1	0	40	60	100	
PHDFT-204-20		Processing Technology for Bioactive Compounds	3	1	0	40	60	100	
PHDFT-301-20	Interdisciplinary Course (Any One)	Intellectual Property Rights	3	1	0	40	60	100	4
PHDFT-302-20		Product Design & Development	3	1	0	40	60	100	
PHDFT-303-20		Project Planning & Implementation	3	1	0	40	60	100	
PHDFT-304-20		Food Supply Chain Management	3	1	0	40	60	100	
PHDFT-401-20	Core Presentation	*Presentation	0	0	6	75	-	75	3
		Total	11	3	6	215	200	425	17

\*Minimum two presentation related to proposed research area of the candidate

\*Non-University Exam

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## 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

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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

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