

Programme Name	Ph.D.	Programme Code	
Course Code	DSE704	Credit	4
Year/Sem	1/1	L-T-P	4-0-0
Course Name	Bio-Analytical & Microbial Techniques		
<b>Objectives of the Course:</b>			
<ol style="list-style-type: none"> <li>1. To provide scientific and computational knowledge related to various techniques associated with biotechnology.</li> <li>2. To impart laboratory skills for handling analytical tools in industry and research institution.</li> <li>3. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.</li> <li>4. To demonstrate the operating procedures associated with upstream and downstream process like chromatography, electrophoresis, centrifugation, etc.</li> </ol>			
<b>UNIT I CHROMATOGRAPHY &amp; CENTRIFUGATION</b> ((Total Topics -10 and Hrs-10)			
General principle and application chromatography, Gas chromatography, Paper chromatography, Thin layer chromatography, HPLC (High Performance/Pressure Liquid chromatography). Centrifugation: Principle and application. Common centrifuges used in laboratory Types of rotors (fixed angle, swing bucket), Types of Centrifugation: Preparative, differential & density gradient.			
<b>UNIT-II SPECTROSCOPY &amp; MICROSCOPY</b> (Total Topics -9 and Hrs-10)			
Spectroscopic methods: principle and applications of UV-visible, FTIR. Principle & application of X-ray crystallography. Basic knowledge of the principles and applications of Microscopy: Light, phase contrast, Fluorescence and Transmission Electron microscopy			
<b>UNIT- III MICROBIOLOGICAL TECHNIQUES</b> (Total Topics -8 and Hrs-10)			
Media preparation (Selective and differential), Sterilization techniques, isolation and maintenance of bacterial and fungi cultures, staining techniques, biochemical characterization, antimicrobial assay along with determination of MIC.			
<b>UNIT-IV MOLECULAR TECHNIQUES</b> (Total Topics -8 and Hrs-10)			
Electrophoresis- General principle and application electrophoresis, Agarose gel electrophoresis, SDS- PAGE, Blotting techniques. Working & application of RT-PCR, Gel DOC.			
<b>Course Outcomes (COs):</b>			
<b>CO1.</b> Development of scientific, computational and analytical knowledge regarding principle and application of advanced analytical techniques in the field of biotechnology and microbiology.			
<b>CO2.</b> Comprehension of microbial techniques and processes for isolation and screening of microbes isolated from different environment and sources.			
<b>CO3.</b> Exhibit skills to pertaining to analytical characterization of biological samples.			
<b>CO4.</b> Apply modern techniques and their statistical knowledge for solving various scientific problems in industry and research institution.			
<b>References Books :</b>			
<ol style="list-style-type: none"> <li>1. Sharma, V.K., <i>Techniques in Microscopy and Cell Biology</i>, Tata McGraw Hill, 1991.</li> <li>2. Alberts, B., <i>Molecular Biology of the cell</i>, Garland, 1989, 2<sup>nd</sup> edition.</li> <li>3. Robyt, J.F. and White B.J., <i>Biochemical Technique: Theory &amp; Practical</i>, Waveland Press, Inc.</li> <li>4. Wilson, K. and Walker, J., <i>Practical Biochemistry</i>, University of Hertfordshire Cambridge University Press, 4<sup>th</sup> edition.</li> </ol>			



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Arcadia Grant, P.O. Chandanwari, Premnagar, Dehradun, Uttarakhand

Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	DSE704	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Research & Instrumentation Techniques		

## Objectives of the Course:

1. To learn & apply concept of Thermogravimetric techniques in research.
2. To provide knowledge about spectroscopic techniques for research.

## UNIT I (Total Topics-12 and Hrs-12 )

### UV-Visible spectroscopy

Basic principle, Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, molar extinction coefficient, concept of chromophores and auxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic, UV spectra of conjugated enes and enones, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fiesher rules for conjugate dienes and carbonyl compounds.

### Infrared spectroscopy

Infra-red spectroscopy: Basic principle, Instrumentation Selection rules, fundamental modes of vibration, overtones, combination bands, Fermi resonance, Factors affecting IR spectra. Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric Interactions with molecules: absorption and scattering. Means of excitation (light sources), detection of the signal (heat differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Interpretation of IR spectra of aliphatic, aromatic hydrocarbons, amines, amides, carbonyl compounds etc

## UNIT- II(Total Topics- 12 and Hrs-12 )

### NMR spectroscopy

Principle, Instrumentation, Factors affecting chemical shift, Uses of TMS equivalent and non-equivalent protons, chemical shifts, factors affecting chemical shifts, shielding of magnetic nuclei, deshielding, anisotropic effects in alkene, alkyne, aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange, Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

### Thermal methods of analysis:

Thermal methods: Principle & application of Thermogravimetric analysis; TGA, DTA & DSC , DSC : Principle instrumentation and applications.

## UNIT-III (Total Topics- 12 and Hrs- 12 )

**Microscopic Techniques:** Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunneling microscopy (STM), Introduction & application of Bio analytical techniques



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## UNIT-IV (Total Topics- 12 and Hrs-12 )

**Physical instrumentation techniques:** Physical Properties: Introduction, & applications of different physical Characteristics: Viscosity, optical activity & conductivity, Instrumentation: Viscometer, pH meter, Refractometer, Polarimeter.

**CO-1: Inculcate knowledge about advanced techniques for physical parameters of materials.**

**CO-2: Apprise UV visible & Spectroscopic techniques.**

**CO-3: Learn interpretation of data used in spectroscopy analysis.**

**CO-4: Learn principle and method of microscopic & thermogravimetric techniques for characterisation of material for research.**

### Reference Books:

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Practical NMR Spectroscopy, ML Martin, JJ Delpach and GJ Martin, Heyden.
4. Fundamentals of Molecular Spectroscopy Colin N. Banwell and Elaine M. Mc Cash Tata McGraw Hill.
5. Introduction to NMR Spectroscopy: RJ Abraham, J Fischer and P Loftus, Wiley.
6. Spectroscopic Method in Organic Chemistry: DH Williams, I Fleming, Tata MacGraw Hill.
7. Instrumental Method of Analysis: Seventh Edition, Willard Merritt, Dean, Settle. CBS



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	DSE704 (i)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advance Food Technology and Quality Management		

## Objectives of the Course:

1. To understand basic concept of advance Food Technology and quality management
2. To aware about advances in food technology
3. To learn food engineering and processing
4. To create concept of food quality control. And quality systems

## UNIT I (Total Topics- 20 and Hrs-5)

### Food Engineering and Processing

Methods of food preservation such as heat processing, pasteurization, canning, dehydration, freezing, freeze drying, fermentation, microwave, irradiation and chemical additives. Aseptic preservation, hurdle technology, hydrostatic pressure technology and microwave processing. Use of non-thermal technologies (microfiltration, bacteriofugation, ultra high voltage electric fields, pulse electric fields, high pressure processing, irradiation, thermosonication), alternate-thermal technologies (ohmic heating, dielectric heating, infrared and induction heating)

## UNIT II (Total Topics-15 and Hrs- 3)

### Technology of Food Products of Plant Origin

Post-harvest management of fruits and vegetables, Biochemical and physical changes during ripening of fruits & vegetables, respiration and factors affecting it, role of ethylene in accelerated ripening, post-harvest treatments for extension of shelf-life of fresh produce, Strategic interventions to minimize postharvest losses including vapour heat treatment, wax coating, chemicals, etc. Biochemical changes during germination, development and maturation of cereals, oilseeds and pulses, Chemical composition and nutritive values of cereals (rice, wheat, maize, sorghum and bajra), oilseeds (groundnut, cotton seed, castor, sesamum rape and mustard) and pulses crop (bengal gram, pigeonpea) Basic principles involved in fermentation, Technological aspects of pickled vegetables like sauerkraut, cucumbers, Technology of wine, beer and distilled alcoholic beverages, defects in alcoholic beverages. Advances in milling of rice and Turbo milling of wheat. Bakery products; role of ingredients, Developments in manufacturing processes for bakery products such as breads; biscuits; pizza bases, cake etc; changes during processing of bakery products. Utilization and importance of dairy ingredients in bakery products. Important group of enzymes involved in food processing; Application of enzymes in food processes like enzymes juice extraction, juice clarification, in bread manufacture, meat tenderization, ice cream manufacture, de- sugaring of egg. Basic principles involved in fermentation, Technological aspects of pickled vegetables like sauerkraut, cucumbers, Technology of wine, beer and distilled alcoholic beverages, defects in alcoholic beverages. Newer concepts in food processing including organic foods, processing of organic raw material, genetically modified foods.

## **UNIT- III (Total Topics- 15 and Hrs-3)**

### **Technology of Food products of Animal origin**

Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk. Milk products processing viz. cream, butter, ghee, cheese, condensed milk, evaporated milk, whole and skimmed milk powder, ice-cream, butter oil, khoa, channa, paneer and similar products. Scope of meat, fish and poultry processing industry in India. Slaughter and dressing of various animals and poultry birds. Post mortem examination. Rigor mortis. Retail and wholesale cuts. Factors affecting meat quality. Curing, smoking, freezing, canning and dehydration of meat, poultry and their products. Sausage making. Microbial factors influencing keeping quality of meat. Processing and preservation of fish and its products. Meat tenderization and role of enzymes in meat processing. Utilization of by-products.

## **UNIT-IV (Total Topics- 15 and Hrs-3)**

### **Food Quality**

Food Quality Management Objectives, importance and functions of quality control. Quality systems and tools used for quality assurance including control charts, acceptance and auditing inspections, critical control points, reliability, safety. Total quality management, good management practices, HACCP and codex in food. International and National food laws. FSSAI. Food adulteration, food safety. Sensory evaluation, panel screening, selection methods. Sensory and instrumental analysis quality control.

## **UNIT-V (Total Topics-12 and Hrs-8 )**

Fermentation technology, fermented food products (animal and plant based), microbial spoilage of foods. Use of biotechnology in production of food additives viz. preservatives, colorants, flavours. Use of biotechnologically improved enzymes in food processing industry, biomass production using industrial wastes. Single cell proteins, Food contaminants viz. aflatoxins. Food intoxication and infection. Consumer concerns about risks and values, Biotechnology and food safety.

### **Course outcome**

**CO1:** Familiarize with the instruments used in food analysis.

**CO2:** Construct relationship between farm to various methods of processing, production and utilization in the cereals, fruits and vegetable and beverage industry

**CO3:** Analyse the quality attributes, their measurement principle in the dairy and meat industry

**CO4:** Apply the food laws with their amendments and regulation guidelines

**CO5:** Understanding the concept of food biotechnological aspects and functional foods

### **Reference Books**

1. *B. Srilakshmi, Food science, New Age Publishers, 2002*
2. *Roday, S. Food Science, Oxford publication, 2011.*
3. *Unit operations of Agricultural processing K.M Sahay & K.K Singh*



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4. *Introduction to Food Process Engineering Ramco.T. Toledero*
5. *Chakraborty., Post Harvest Technology of Cereals, Pulses and Oilseeds, revised ed., Oxford & IBH Publishing Co. Pvt Ltd, 1988*
6. *Cereals Technology by Samuel A.Matz. CBS Publications.*
7. *Food Facts and Principles by Mannay;New age International (P) Ltd.*
8. *.Biochemistry by LubertStryer. Publisher:WH Freeman; Edition VI.*
9. *2.Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. Publisher: McGraw Hill; Edition 28.*
10. *De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford.2007*
11. *Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992*
12. *Fermentation Biotechnology: Principles, Processes and Products, Ward OP, 1989, Prentice-Hall.*
13. *. Frazier, W.C. Food Microbiology. 4th edition. Mc Graw Hill. New York, 2008*
14. *Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999*
15. *Pieterneel A, Luning, Willem J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen,2009.*



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Programme Name	<b>Pre-Ph.D. Course Work</b>	Programme Code	23-
Course Code	DSE704 (ii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Food Chemistry and Analytical Techniques		

## Objectives of the Course:

1. To understand the importance of food Science and food chemistry.
2. To develop basic concept about applied nutrition.
3. To acquire basic knowledge of preparation and standardization of solutions
4. To have sound knowledge of operation of sophisticated instruments
5. To impart knowledge about newer techniques such as immunoassay and thermal analysis

## UNIT I (Total Topics- 8 and Hrs- 8)

Definition and importance; major food constituents and their physicochemical properties; role of water in food. Carbohydrates, proteins and lipids: classification, physical, chemical, nutritional, and functional properties and their structural correlations; auto-oxidation of lipids and rancidity.

## UNIT II (Total Topics- 10 and Hrs-8)

Properties of minerals, vitamins, pigments, anti-oxidants, flavour components, allergens, toxins and anti-nutritional factors in foods; Interaction of constituents in food systems; Changes during storage and processing; Browning reactions in foods. Preparation of Chemical solutions: Preparation of solutions and their types. pH and Buffers: Importance and measurement of pH.

## UNIT- III (Total Topics -10 and Hrs-8)

Food groups and their typical composition; essential nutrients- sources, functions, deficiency diseases; requirements and recommended dietary allowances; digestion, absorption, transport and metabolism of nutrients in human system; protein quality evaluation. Water activity: its measurements and significance in food quality, calibration and standardization of different instruments. Definition of sample and sampling equipments.

## UNIT-IV (Total Topics 10 and Hrs-8)

Chromatographic Techniques: General principles. Classification of Chromatographic techniques Partition and adsorption chromatography. Paper, thin layer, gas liquid, ion exchange and affinity chromatography. Gel filtration. Introduction to High Pressure Liquid Chromatography. Electrophoresis and Microscopic Techniques: General principles. Paper electrophoresis, Types of gel electrophoresis, SEM, TEM, Compound microscope, Light

microscope.

## UNIT-V(Total Topics -10 and Hrs-10)

Spectroscopy: Beers and Lambert's law. Extinction coefficient. General principles of colorimeters and spectrophotometers, Atomic spectroscopy, Emission spectroscopy, IR spectroscopy. Flame photometer, FTIR. Special techniques: Immunoassay techniques: Isotopic, non – isotopic and enzyme immunoassays: surface tension: Enzymatic methods of food analysis: thermal methods in food analysis (Differential scanning calorimetric and others)

### Course Outcome

**CO 1:** Create a depth of knowledge about compositional, nutritional technological aspect of plant and animal food.

**CO 2:** Identify different type of browning in food which help in estimating quality of food both at industrial and domestic purpose

**CO 3:** Analyse different type of food groups their RDA and standardization of instruments

**CO-4:** Apply and Understand the basic steps in thermal processing and their working principles

**CO-5:** Adapt different techniques used during preparation and preservation of foods.

### Reference Books

1. *Roday, S. Food Science and Nutrition*, Oxford publication, 2011, 2<sup>nd</sup> Edition
2. *Srilakshmi, B. Food science*, New Age Publishers, 2016, 6<sup>th</sup> Edition.
3. *Manay, N.S. and Shadaksharaswamy, M. Foods Facts and Principles*, New Age Publishers, 2020, 10<sup>th</sup> edition.
4. *Bamji MS, Rao NP & Reddy V. Textbook of Human Nutrition*. Oxford & IBH. 2003.
5. *Joshi SA.. Nutrition and Dietetics*. Tata McGraw Hill. 1999
6. *Khanna K, Gupta S ,Passi SJ, Seth R & Mahna R.. Nutrition and Dietetics*. Phoenix Publ. 1997
7. *Swaminathan M. Essentials of Foods and Nutrition*. Vol. II. Ganesh & Co. London. 1974.
8. *Advances in Food and Nutrition Research*. Elsevier Book Series.
9. *Aurand LW, Woods A & Wells MR. Food Composition and Analysis*. AVI Publ. 1987
10. *B. Food Science*, New Age International Private Limited.
11. *Raju N.V.S., Total Quality Management*, Cengage Learning India Private Limited; 1 edition
12. *Walt Boyeses, Instrumentation reference Book*, Elsevier Inc. 2010.
13. *B C Nakra, K K Chaudhry. Instrumentation Measurements and Analysis*, Tata McGraw-Hill Publishing Company Limited. 2004
14. *Jack Cazes, Ewing's analytical Instrumentation Hnadbook*, CRC Press Taylor & Francis Group. 2004.
15. *Bela G. Liptak, Analytical Intrumentation*, Chilton Book Company. 1994.



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16. *Wilson K. and Walker J., Principle and techniques of Biochemistry and Molecular Biology, Cambridge University Press.*  
*Keith Wilson and John Walker, Biophysical chemistry principle and techniques. Himalayan Publishing House.*