

DEPARTMENT OF HOME SCIENCE

SEMESTER 5

B.Sc. Hons (Food Technology)

DISCIPLINE SPECIFIC CORE COURSE

DSC FT13: Food Microbiology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Theory	Tutorial	Practical/Practice		
Food Microbiology	4	3	0	1	XII Pass with PCM/PCB	Nil

Learning Objectives

- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.

Learning Outcomes

Upon completion of this course, students are expected to:

- Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
- Understand the role and significance of intrinsic and extrinsic factors on growth and response of microorganisms in foods.
- Identify ways to control microorganisms in foods.
- Identify the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.
- Describe the beneficial role of microorganisms in fermented foods and in food processing.
- 6. Utilize laboratory techniques to detect, quantify, and identify microorganisms in foods.

- Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.
- Develop success skills in communication, critical thinking, interaction, information acquisition and interpretation and life-long-learning.

SYLLABUS OF DSC FT13

THEORY

Credits: 3; Hours: 45

UNIT I: Microorganisms in food

15 Hours

Unit Description: The unit shall introduce students to the world of food microbiology. The structure and growth of bacteria, yeast, mold and virus in food as well as how the intrinsic and extrinsic factors affect the growth of microorganisms shall be taken up. The growth curve of bacteria will be covered to understand various phases of growth.

Subtopics:

- Introduction, history and scope of food microbiology.
- Morphological and physiological features of bacteria, yeast, mold. Introduction to bacterial endospores and capsules. Food borne viruses and their reproduction.
- Growth curve of bacteria.
- Factors affecting growth of microbes in foods.
- Role of microorganism in fermentation, spoilage and food borne diseases.

UNIT II: Cultivation of microorganism

10 Hours

Unit Description: Isolation and cultivation is the heart of microbiology. Therefore, the various techniques related to their cultivation and enumeration shall be taught. Although some are already taken in practicals but not all of them. A theoretical insight is needed.

Subtopics:

- Principles of cultivation of microorganism (purity, activity etc.).
- Pure culture technique.
- Methods of isolation and enumeration (including latest ones).
- Rapid methods of bacteria detection.

UNIT III: Microbial food spoilage

10 Hours

Unit Description: Food is the best substrate for the microorganism to grow, multiply and cause undesirable changes. The spoilage of raw as well as processed foods is very common. Therefore, as a food processor the understanding of food spoilage is very important for the students, in order to preserve the food.

Subtopics:

- Sources of microorganism in foods.
- Spoilage in milk, meat, cereals, fruits and vegetables (and few associated products).
- Spoilage in canned foods.

UNIT IV: Food preservation by novel technologies

10 Hours

Unit Description: There are many convention and new methods of food preservation. The novel methods cause minimum changes in sensory and nutritive properties of food. It is imperative to teach such methods and their application in food preservation.

Subtopics:

- Conventional methods of food preservation- an overview.
- Non-thermal methods such as pulse electric field preservation, high hydrostatic pressure, ohmic heating, irradiation, biopreservation etc. to be familiarized.
- Hurdle concept and minimal processing.

PRACTICAL
Credit: 1; Hours: 30

1. Introduction to the Basic Microbiology Laboratory Practices and Equipment's
2. Functioning and use of compound microscope
3. Cleaning and sterilization of glassware
4. Preparation and sterilization of nutrient broth
5. Preparation of slant, stab and plates using nutrient agar
6. Cultivation and sub-culturing of microbes
7. Morphological study of bacteria and fungi using permanent slides
8. Simple staining
9. Gram's staining
10. Standard Plate Count Method

Essential Readings

- Frazier William C and Westhoff, Dennis C. Food Microbiology, TMH, New Delhi, 2004
- Jay, James M. Modern Food Microbiology, CBS Publication, New Delhi, 2000
- Garbutt, John. Essentials of Food Microbiology, Arnold, London, 1997
- Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993
- W. M. Foster (2020) Food Microbiology. CBS Publishers & Distributors Pvt Ltd.

Suggested Readings

- Bibek Ray and Arun Bhunia. Fundamentals food microbiology, 5th Ed, CRC Press, 2014.
- K.R. Aneja. Experiments in microbiology, plant pathology, tissue culture and microbial biotechnology, New age international publishers, 2018.
- Roger Y. Stanier. General Microbiology, Macmillan, 1987.
- K.R. Aneja. Modern Food Microbiology, Medtech, 2018

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE**DSC FT14: Food Engineering II****CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE**

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Theory	Tutorial	Practical/Practice		
Food Engineering II	4	3	0	1	XII Pass with PCM/PCB	Appeared in Food Engineering- I

Learning Objectives

- To understand the principle of size reduction and mixing unit operations
- To acquaint with fundamentals of fluid flow process and psychrometrics
- To understand the basics of designing of evaporator and dehydrator

Learning Outcomes

After completing this course, students will be able to:

- Apprehend the principles of size reduction and mixing unit operations.
- Comprehend the applications of fluid flow, steam and psychrometrics
- Understand basic design of evaporator and dehydrator used in food processing
- Apply these principles for solving numerical problems

SYLLABUS OF DSC FT14**THEORY**

Credits: 3; Hours: 45

UNIT I: Introduction to Size Reduction and Mixing Operations

10 hours

Unit Description: The unit will provide information on the application of size reduction and mixing unit operations in food processing industry.

Subtopics:

- Introduction of size reduction and mixing operation
- Types of size reduction
- Size reduction equipment (crusher, grinding mill, pulveriser, roller mill, knife cutter)
- Application of size reduction

- Size separation, screening, screening equipment and applications
- Mixing equipment for solids and pastes (Planetary mixer, Kneader, Ribbon mixer, Double cone mixer)
- Applications of mixing in solids and fluids

UNIT II: Fluid Flow in food Processing

11 hours

Unit Description: The unit will provide knowledge of fluid characteristics, viscometers and pressure measuring devices

Subtopics:

- Liquid Transport systems
- Newton's Law of Viscosity
- Principle and operation of Capillary tube and rotational viscometer
- Properties of Non-Newtonian fluids
- Flow characteristics, Reynolds Number, Bernoulli's Equation
- Concept of Flow Measurement devices

UNIT III: Steam and Evaporation

12 hours

Unit Description: The unit will provide an understanding of generation of steam process, functioning and designing of evaporators

Subtopics:

- Generation of steam
- Construction and functions of fire tube and water tube boilers
- Thermodynamics of Phase change
- Steam tables
- Boiling point elevation
- Types of evaporators
- Design of single effect evaporators

UNIT IV: Psychrometrics and Dehydration

12 hours

Unit Description: The unit will provide knowledge of the psychrometrics, dehydration process and designing of dehydrator

Subtopics:

- Properties of dry air, water vapour, air vapour mixture
- Psychrometric Chart and its application
- Basic Drying Process
- Moisture content on wet basis and dry basis
- Dehydration systems
- Dehydration system Design

PRACTICAL **Credit: 1; Hours: 30**

1. Screen analysis of food sample
2. Study the effect of temperature on viscosity of Newtonian / non-Newtonian fluids
3. Operation of pressure measuring instrument
4. Study properties of moist air using Psychrometer and psychrometric chart
5. Determination of evaporation rate of given food sample
6. Determine elevation in boiling point of given solution
7. Study steam table and its application

8. Operation of tray dryer and drying process calculations
9. Determination of drying characteristics of given food sample

Essential Readings

- Fellows, P. (2009). *Food processing technology*. Woodhead publication, 3rd edition
- Rao, D.G. (2010). *Fundamentals of food engineering*. PHI learning private ltd.
- Singh, R.P. and Heldman, D.R. (1993) *Introduction to food engineering* 2nd edition. Academic press
- Singh, R.P. and Heldman, D.R. (2014) *Introduction to food engineering* 5th edition. Academic press

Suggested Readings

- Earle, R.L. (1983). *Unit Operations in Food Processing*, 2nd edition. Pergamon press.
- Garg, M., Chaturvedi, S., Sadhu, S.D. and Barwa, M. and Pani. B ., (2020) *Practical Handbook of Food Engineering* Aryush Education, ISBN NO. 978-81-930437-5-2
- Jafari, Seid Mahdi, ed. (2021) *Engineering Principles of Unit Operations in Food Processing: Unit Operations and Processing Equipment in the Food Industry*. Woodhead Publishing.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE**DSC FT 15: Food Chemistry I****CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE**

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Theory	Tutorial	Practical/Practice		
Food Chemistry I	4	3	0	1	XII Pass with PCM/PCB	Nil

Learning Objectives

- To understand the composition of food.
- To learn the structure, interaction, importance & stability of macro & micro components.
- To understand the functional aspects of food components and to study their role in food processing.

Learning Outcomes

After completing this course, students will be able to:

- Understand and describe the general chemical structures of the major & minor components of foods.
- Give a molecular rationalization for the observed physical properties and reactivity of the food components.
- Provide a theoretical explanation for observed extent and rates of reactions that are common to foods
- Predict how processing conditions are likely to change the reactivity of food components

THEORY

Credits: 3; Hours: 45

Unit I: Introduction to Food Chemistry

2 Hours

Unit II: Water

8 Hours

- Definition of water in food
- Structure of water and ice
- Types of water

- Sorption phenomenon
- Water activity and packaging
- Water activity and shelf-life

Unit III: Macronutrients

26 Hours

Lipids

- Classification of lipids
- Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point.
- Chemical properties-reichert meissl value, polenske value, iodine value, peroxide value, saponification value.
- Effect of frying on fats
- Changes in fats and oils- rancidity, lipolysis, flavor reversion
- Auto-oxidation and its prevention
- Technology of edible fats and oils- Refining, Hydrogenation and Interesterification, Fat Mimetics

Proteins

- Protein classification and structure
- Properties of proteins (electrophoresis, sedimentation, amphotericism and denaturation,)
- Functional properties of proteins eg. organoleptic, solubility, viscosity, binding gelation / texturization, emulsification, foaming.

Carbohydrates

- Classification (mono, oligo and poly saccharides)
- Structure of important polysaccharides (starch, glycogen, cellulose, pectin, hemicellulose, gums)
- Chemical reactions of carbohydrates –oxidation, reduction, with acid & alkali
- Modified celluloses and starches

Unit IV : Micronutrients

11 Hours

Vitamins

- Structure, Importance and Stability
- Water soluble vitamins
- Fat soluble vitamins

Minerals

- Major and minor minerals
- Metal uptake in canned foods
- Toxic metals

PRACTICALS

Credit: 1; Hours: 30

1. Preparation of primary and secondary standard Solutions.
2. Estimation of moisture content.
3. Determination of gelatinization temperature range (GTR) of different starches and effect of additives on GTR.
4. Determination of refractive index and specific gravity of fats and oils.
5. Determination of smoke point and percent fat absorption for different fat and oils.
6. Determination of percent free fatty acids.
7. Estimation of saponification value.
8. Estimation of total ash content.

Essential Readings

- DeMan, J.M.(2018).Principles of Food Chemistry.NewYork: AVI.
- Fennema, Owen R. (2017).Food Chemistry. 3rd Ed..NewYork: Marcell Dekker
- Whitehurst and Law.(2002).Enzymes in Food Technology. Canada: CRC Press.

Suggested Readings

- Potter, N.N. and Hotchkiss, J.H. (1999). Food Science, 5th Ed., Chapman & Hall.
- Wong, Dominic WS. (2018). Food Enzymes. New York: Chapman and Hall.
- Meyer, L.H. (2004). Food Chemistry. CBS Publishers & Distributors Pvt Ltd, India.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE**DSE FT03 A: Food Fermentation Technology****CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE**

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Theory	Tutorial	Practical/ Practice		
Food Fermentation Technology	4	2	0	2	XII Pass with PCM/PCB	Nil

Learning Objectives

- To understand the concept and significance of fermentation
- To understand the principles of food fermentation technology
- To study the types of starters used in the food industry
- To study the production of various fermented foods

Learning Outcomes

- An understanding of the basic components of Food Fermentation Technology and their principles.
- An understanding of the concept of the different fermentation processes.
- Develop insight into common types of starters used in the Food Industry.
- Apply acquired skills in the production of various fermented foods.

SYLLABUS OF DSE FT 03**THEORY****Credits: 2; Hours: 30****UNIT I: Introduction to fermentation****10 Hours**

Unit description: This unit introduces the concept of fermentation as a process ,its basic requirements and types . It also covers the types of microbes required in the process resulting

in the formation of different products along with the emphasis on the significance of fermentation

Subtopics:

- Definition of Fermentation
- Types of fermentation process: submerged/solid state, Batch/continuous fermentation
- Requirements for the fermentation process
- Role of Starter cultures and their types commonly used in fermentation
- Importance of Fermentation

UNIT II: Fermentation Technology

10 Hours

Unit description: This unit covers Food Fermentation Technology with a focus on fermenters and their operations. Both the concept of upstream and downstream processing will be taught along with coproduct recovery

Subtopics:

- Fermenter: design and its operation
- Measurement and control of fermentation
- Upstream processing- screening and identification of microorganisms, media preparation, multiplication of microbes
- Downstream processing -Recovery of fermentation products and conversion into commercially viable products, Co-product recovery, and valorization

UNIT III: Fermented Products

10 Hours

Unit description: This unit describes the fermentation process of various products and their classification with an emphasis on the Indian traditional fermented products.

Subtopics:

- Types of fermented products and their classification
- Fermentation of milk, vegetables, cereals
- Industrial Production of selected products -Baker's yeast, Cider, Vinegar, and Cheese
- Traditional Indian Fermented products

PRACTICAL

Credit: 2, Hours: 60

1. To study the design and operation of a lab scale fermenter
2. To study the sugar utilization patterns by microorganisms
3. To determine β -galactosidase activity of microorganisms
4. To perform Solid State Fermentation using byproducts as a substrate at lab scale.
5. To produce Baker's Yeast
6. To prepare Sauerkraut
7. To prepare Curd /Yogurt
8. To develop a fermented food/drink utilizing plant products or their by- products
9. To develop a fermented food/drink utilizing animal products or their by-products

Essential Readings

- Brian, J. Wood. (1997). *Microbiology of Fermented Foods*. Volume II and I. Elsevier Applied Science Publication.

- Joshi, V.K. & Pandey. A. (2009). *Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology*. Volume I and II. Asiatech Publishers Inc.
- Stanbury, P.F., Whitekar A. and Hall (2013). *Principles of Fermentation Technology*. Reed Elsevier India Pvt.Ltd.

Suggested Readings

- Adams, M. & Moss, M. (2008). *Food Microbiology*. 2nd Edition. RSC Publishing.
- John, Garbutt. (1997). *Essentials of Food Microbiology*. Arnold International Students Edition.
- Arnold L. Demain & Julian E. Davis. *Industrial Microbiology & Biotechnology*, ASM Press. (2004).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

GENERIC ELECTIVE COURSE
GE FT05: Food Engineering and Packaging Technology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Theory	Tutorial	Practical/Practice		
Food Engineering and Packaging Technology	4	3		1	XII Pass with Science	

Learning Objectives

1. understand the fundamental engineering principles of Unit operations.
2. To acquaint with fundamentals of food engineering and its process.
3. To develop an understanding of the various packaging materials, techniques and package design used for food packaging.

Learning Outcomes

After completing this course, students will be able to:

1. Understand the principles of Unit operation
2. Acquaint with fundamentals of food engineering and its processes
3. Develop an understanding of different food packaging materials and packaging design and techniques used for various foods

SYLLABUS

THEORY
Credits 3 (45 Hrs.)

UNIT I:

Unit Operations and Processes: Engineering Concepts

20 hours

- Units and Dimensions, Mass and Energy Balance
- Food Plant Layout and Design.

- Heat transfer- Laws of Conduction, convection, Radiation
- Steam: Thermodynamics of Phase change, Pressure enthalpy diagram, Boilers
- Evaporation – Evaporator types and Design of single effect evaporator
- Dehydration- Basic drying process and Principle
- Refrigeration and Freezing -VCR System, Pressure Enthalpy Charts, Mathematical expressions useful in analysis of VCR System. Freezing time prediction- Plank's Equation
- Psychrometrics- Psychrometric Chart construction and uses
- Fluid flow-Liquid Transport system, Properties and Classification of fluids, Reynolds number.

UNIT II:

Separation and Size Reduction Processes

10 hours

- Principle and equipment used for Filtration, Extraction, Distillation, Centrifugation, Sieving.
- Milling, Grinding and Mixing of Foods

UNIT III:

Food Packaging

15 hours

Food Packaging- Concept, Functions and Significance. Manufacturing Process and Application of Rigid, Semi Rigid and Flexible Food Packaging Material. Aseptic, Intelligent and Active packaging. Packaging Techniques for Fresh Agricultural Produce, and Processed Foods.

PRACTICAL (Credit 1; Hours 30)

- Study the dehydration process of foods.
- Study the freezing characteristics of foods.
- Study the evaporation process.
- Study and use of psychrometric chart.
- To design layout of a food plant.
- Sieve analysis of Food samples.
- Determination of viscosity of foods using Viscometer.
- Identification and Testing of packaging materials.
- Demonstration of vacuum/gas packaging of foods.

Essential Readings (Theory):

1. Singh, R.P. and Heldman, D.R.(2013).Introduction to food engineering, 5thEd. Academic Press

2. Rao, D.G.(2010).Fundamentals of food engineering. PHI learning private Ltd.
3. Robertson, (2012) Food Packaging: Principles and Practices , CRC Press
4. Saha, N.C., Ghosh, A.K., Garg, M., Sadhu, S.D (2022) Food Packaging :Materials, Techniques and Environmental Issues, publisher springer
5. Kshitiz Kumar, Pravin M Ganorkar, Vijay Singh Sharanagat (2023). Food Packaging-Principles and Applications. Nipa® genx electronic resources & solutions p. Ltd. New Delhi.

Essential Readings (Practical):

1. Meenakshi Garg, Premlata Meena, Sushmita D Sadhu, Tanveer Alam. “Food Packaging: A Practical Guide” The Computype Media (Publishing Division), ISBN No.614027934-9; 2020.