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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20FP2031** | **Duration** | **3hrs** |
| **Course Title** | **REFRIGERATION AND COLD STORAGE ENGINEERING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Recall the term "Ton of Refrigeration" and mention its value in SI units. | | CO1 | U | 1 |
| 2. | Compare primary and secondary refrigerants. | | CO1 | R | 1 |
| 3. | Recall the principle of Winter Air Conditioning and All-Year Air Conditioning Systems. | | CO2 | R | 1 |
| 4. | What is meant by a 'Simple Air Conditioning System' | | CO2 | R | 1 |
| 5. | List the essential factors to consider in the design of a cold storage facility | | CO3 | U | 1 |
| 6. | Name two commonly used insulating materials in cold storage. | | CO3 | R | 1 |
| 7. | Infer two types of equipment used for chilling liquid foods | | CO4 | U | 1 |
| 8. | List the role of secondary refrigerants in a chilling system | | CO4 | R | 1 |
| 9. | Infer the significance of IQF. | | CO5 | U | 1 |
| 10. | Interpret the importance of traceability in the cold chain | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Schematically represent a plot of PV graph for isothermal process | | CO1 | An | 3 |
| 12. | Interpret the 'design conditions' in air conditioning system planning. | | CO2 | U | 3 |
| 13. | Identify the optimum storage temperature for fish and apple. | | CO3 | An | 3 |
| 14. | Infer one microbiological concern in chilled food and how packaging helps to address it. | | CO4 | U | 3 |
| 15. | Identify the effect of freezing rate ice crystal size and food texture. | | CO5 | An | 3 |
| 16. | Outline two parameters monitored during cold chain transportation and explain their significance | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | A cold storage plant is required to store 20 tonnes of fish. The temperature of the fish when supplied = 250C., storage temperature of fish required = -80C, specific heat of fish above freezing point= 2.93 kJ/kg 0C, specific heat of fish below freezing point= 1.25 kJ/kg 0C, freezing point of fish = -30C, latent heat of fish= 232 kJ/kg.  If the cooling is achieved within 8 hours, find out:  (i) capacity of the refrigerating plant (ii) carnot cycle COP between this range (iii) if the actual COP is 1/3 rd of the carnot COP, find out the power required to run the plant. | CO1 | AN | 10 |
|  | b. | List the major components of a Vapour Compression Refrigeration system. | CO1 | U | 2 |
|  |  |  |  |  |  |
| 18. | a. | Describe different types of loads and explain how air is transmitted and distributed in an air conditioning system | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the design and construction of a cold storage facility. | CO3 | U | 6 |
|  | b. | Summarize its steps involved in cold load estimation | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Explain the basics of chilled food microbiology and illustrate how packaging and chilled food transport systems help in preserving food quality and safety. | CO4 | U | 12 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| 21. | a. | Summarize various types of freezers used in the food industry. | CO5 | U | 6 |
|  | b. | Describe freezing practices for different food sectors | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the concept of a cold chain and describe its key components. | CO6 | U | 6 |
|  | b. | Outline the importance of refrigerated transport and distribution in maintaining food quality. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the principle of evaporative cooling and summarize the applications evaporative cooling in chilling systems of liquid foods | CO4 | U | 8 |
|  | b. | How does crystal size influence the texture and quality of frozen foods | CO6 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain how RFID, barcoding, and monitoring systems help maintain product quality and traceability | CO6 | U | 8 |
|  | b. | Write short notes on temperature and moisture monitoring | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the principle of refrigeration and various refrigeration cycles |
| **CO2** | Understand factors affecting cold storage of food commodities |
| **CO3** | Calculate the thermal load for the air conditioning system |
| **CO4** | Analyze freezing and its effect on the texture of food |
| **CO5** | Predict the problems encountered in chilling of foods |
| **CO6** | Design cold supply chain management systems for food sector |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20FP2036** | **Duration** | **3hrs** |
| **Course Title** | **PROCESS ECONOMICS AND PLANT LAYOUT DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the technical feasibility. | | CO1 | R | 1 |
| 2. | Define the term PID. | | CO2 | R | 1 |
| 3. | State the full form of PQRST. | | CO1 | R | 1 |
| 4. | List the 5P’s of good manufacturing practices. | | CO1 | R | 1 |
| 5. | Define fixed cost. | | CO4 | R | 1 |
| 6. | Identify break-even point. | | CO4 | R | 1 |
| 7. | Define depreciation cost. | | CO4 | R | 1 |
| 8. | Quote the formula for average rate of return. | | CO5 | R | 1 |
| 9. | List any two external issue occuring in operational study. | | CO1 | R | 1 |
| 10. | Define PCD. | | CO2 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the components of the PIECES framework. | | CO1 | U | 3 |
| 12. | Describe the primary criteria to be considered while selecting a site for plant layout. | | CO2 | U | 3 |
| 13. | Indicate the various components of plant overhead costs. | | CO4 | U | 3 |
| 14. | State the principles of HACCP. | | CO1 | R | 3 |
| 15. | Explain the PROs and CONs using the discounted cash flow. | | CO5 | An | 3 |
| 16. | The company has generated a total return of 40 crores in 5 years. His initial investment was four crores. Calculate the rate of return on investment of his venture. | | CO5 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the principles of plant layout. | CO2 | U | 6 |
|  | b. | Explain the sanitary design principle for equipment according to 3-A Sanitary Standards, USDA, and EHEDG. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the factors affecting the plant layout design and construction. | CO1 | U | 6 |
|  | b. | Explain the types of workplace hazards and their preventive measures as per OSHA guidelines. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Examine the steps involved in developing a flow chart for a process. | CO3 | U | 6 |
|  | b. | Evaluate the impact of computer-aided process design (CAPD) on improving the efficiency and sustainability in food plant design. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Interpret the importance of each key element in a food safety management system. | CO1 | U | 6 |
|  | b. | Describe the tools used in systematic plant layout and their functions. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Indicate the objectives of project evaluation. | CO4 | U | 6 |
|  | b. | Explain the mathematical methods for profitability evaluation. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the manufacturing cost analysis with the necessary calculation. | CO4 | A | 6 |
|  | b. | Explain the profitability analysis process with an example. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Summarize the methods of project evaluation. | CO5 | U | 6 |
|  | b. | Explain the concept of discounted cash flow and its significance in project evaluation with the help of a labelled diagram. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24 |  | Develop the plant layout of a rice milling industry, highlighting the major processing sections, and factors influencing the layout design. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Gain knowledge on the various factors involved in setting up a Food Processing Industry. |
| **CO2** | Understand the process of food plant layout design. |
| **CO3** | Apply their knowledge to design projects for setting up a Food Processing Industry. |
| **CO4** | Analyze the problems involved in deciding the level of manufacture of a food product. |
| **CO5** | Evaluate the options involved and decide on the right choice based on the economics of the system. |
| **CO6** | Develop own industry or plan turn-key projects based on the request from customers. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20FP2037** | **Duration** | **3hrs** |
| **Course Title** | **FAT AND OIL PROCESSING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List two examples of saturated fatty acids. | | CO1 | U | 1 |
| 2. | Define Peroxide value. | | CO1 | R | 1 |
| 3. | Recall two health benefits of Virgin Coconut Oil. | | CO5 | R | 1 |
| 4. | Define oil extraction. | | CO2 | R | 1 |
| 5. | Indicate the undesirable effects of deodorization. | | CO3 | R | 1 |
| 6. | Identify the key steps in neutralization of oil. | | CO3 | R | 1 |
| 7. | Recall the compounds responsible for off flavour in oils. | | CO4 | R | 1 |
| 8. | Express the key benefits of flexible pouches for packaging edible oils. | | CO6 | R | 1 |
| 9. | Recall two materials used for making rigid containers. | | CO6 | R | 1 |
| 10. | List any two examples of speciality fats. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast vegetable fats and animal fats. | | CO1 | An | 3 |
| 12. | Illustrate the flowchart for the extraction of Soyabean oil. | | CO2 | U | 3 |
| 13. | Describe briefly the hydrogenation process for fats and oils. | | CO3 | An | 3 |
| 14. | Differentiate between oxidative rancidity and hydrolytic rancidity. | | CO4 | An | 3 |
| 15. | List the main requirements of edible oil packaging materials. | | CO6 | An | 3 |
| 16. | Describe the concept of liquid oil technology. | | CO5 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Interpret the various chemical reactions of fats and oils. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the mechanical methods of oil extraction with a suitable diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Discuss a detailed note on the bleaching of vegetable oils. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Summarize the major volatile compounds present in fats and oils | CO4 | U | 6 |
|  | b. | Describe the factors affecting quality of fats and oils. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Describe the packaging process for vanaspati and ghee, emphasizing methods that enhance shelf life and prevent rancidity. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the conventional and modern methods of coconut oil extraction. | CO2 | U | 6 |
|  | b. | Outline the sesame oil extraction process using a flow diagram. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. |  | Survey the solvent extraction methods and refining process of rice bran oil. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Propose a sustainable utilization plan for by-products in a medium-scale edible oil processing unit. | CO3 | C | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the importance of fats and oils in human diet. |
| **CO2** | Describe the manufacturing process of oils and fats. |
| **CO3** | Apply knowledge on manufacture to design alternate fats. |
| **CO4** | Analyze the quality attributes of oils and fats. |
| **CO5** | Defend the use of specialty fats to meet human dietary requirement. |
| **CO6** | Design suitable packaging materials for fats and oils. |

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**END SEMESTER EXAMINATION – NOV/DEC 2025**

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| **Course Code** | **20FP2038** | **Duration** | **3hrs** |
| **Course Title** | **DRYING TECHNOLOGY OF FOOD MATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Express the Henderson’s equation for the given data: RH = 50%; T = 60℃ Me = 7.54 % (db) | | CO1 | U | 1 |
| 2. | Define the hysteresis effect. | | CO1 | R | 1 |
| 3. | State any two characteristics of convection drying systems. | | CO2 | R | 1 |
| 4. | Examine the significance of a hybrid-type solar grain dryer. | | CO2 | R | 1 |
| 5. | Identify the performance objectives of the drying system. | | CO3 | U | 1 |
| 6. | Quote an expression for calculating the rate of fuel consumption. | | CO3 | R | 1 |
| 7. | Interpret the thermal efficiency of a drying system. | | CO4 | U | 1 |
| 8. | List any two air factors considered in the design of heated air grain dryers. | | CO4 | R | 1 |
| 9. | Indicate the significance of drying performance tests. | | CO5 | U | 1 |
| 10. | Express the relation between specific energy consumption (SEC) and COP. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Deduce an expression for a drying operation based on Newton’s equation. | | CO1 | An | 3 |
| 12. | Describe the working principle of a recirculatory dryer. | | CO2 | U | 3 |
| 13. | 500 kg of paddy at 22% moisture content (wb) is dried to 14% moisture content (wb) for milling. Calculate the amount of moisture removed in drying. | | CO3 | An | 3 |
| 14. | Illustrate the three airflow patterns in dryers using a neat sketch. | | CO4 | U | 3 |
| 15. | Analyze the various measured indicators used to evaluate the performance of a dryer. | | CO5 | An | 3 |
| 16. | Interpret the principle of foam mat drying of foods. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze the processes of heat and mass transfer involved in grain drying. | CO1 | An | 6 |
|  | b. | Illustrate the drying theory with the help of a drying curve. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare the thin layer drying with deep bed drying of grains, accompanied by a schematic diagram. | CO2 | E | 8 |
|  | b. | Explain chemical drying in detail, highlighting its merits and demerits. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | In a dryer, 4 tonnes of sorghum (final weight) is dried from 18% (db) moisture content to 13% (db) moisture content per hour. Calculate the heat requirement for drying and the necessary air flow rate for the drying system. Given that:  Drying efficiency = 50%  Latent heat of evaporation = 574 kcal/kg  Specific heat of air = 0.24 kcal/kg°C  Drying air temperature = 44°C  Ambient air condition = 25°C and 20°C dry and wet bulb temperature respectively | CO3 | A | 6 |
|  | b. | Deduce an equation for measuring the air flow rate required for heated air-drying systems by making heat balance. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. |  | Elucidate the construction and operation of the spray dryer with a neat sketch. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Summarize the factors considered in the preliminary selection of a crop dryer. | CO5 | U | 6 |
|  | b. | Analyze the factors affecting the drying characteristics of cereals, pulses, and oilseeds. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Determine the values of c and n from the Henderson equation for the following data obtained from thin-layer paddy drying studies:  RH= 30 per cent, t = 50°C, Me = 10.5 per cent  RH= 55 per cent, t = 50°C, Me = 15.5 per cent | CO3 | A | 6 |
|  | b. | Describe the principle, construction, and operation of the freeze-dryer. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Design a simple test procedure to determine the performance of the batch-type grain dryer. | CO5 | C | 6 |
|  | b. | Compare the direct methods of moisture measurement in detail. | CO1 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the principle, construction, and operation of heat pump dryer, highlighting its applications and advantages. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Gain knowledge on drying principles. |
| **CO2** | Understand different types of dryers for different food materials. |
| **CO3** | Apply the principles to solve problem on drying. |
| **CO4** | Analyze the efficiency of industrial dryers. |
| **CO5** | Evaluate the dryer performance. |
| **CO6** | Design dryers for different types of foods. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20FP3001** | **Duration** | **3hrs** |
| **Course Title** | **MASS TRANSFER AND SEPARATION TECHNIQUES IN FOOD PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the various types of mass transfer processes involved in food processing operations. | CO1 | U | 8 |
|  | b. | Describe the principle, equipment, and process involved in solid–liquid extraction and its applications. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Describe the working principle, advantages, and limitations of any two types of distillation methods. | CO4 | An | 8 |
|  | b. | Explain the construction and working principle of short tube and long tube evaporators with sketches. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Explain the McCabe–Thiele method for designing a continuous rectification column, highlighting the graphical construction, number of stages, feed condition, and reflux ratio. | CO4 | An | 8 |
|  | b. | Describe the different types of gas absorption equipment used in industries. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the factors influencing the equilibrium solubility of gases in liquids and compare the behavior of gases in ideal and non-ideal solutions. | CO1 | An | 8 |
|  | b. | Describe the process and applications of sedimentation thickening in food processing. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Express the principle of constant pressure and constant volume filtration with suitable equations. | CO2 | U | 8 |
|  | b. | Explain the principle of gravity sedimentation and its relation to Stokes law. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | A mixture of He and N2 gas is contained in a pipe at 298 K and 1-atm total pressure which is constant throughout. At one end of the pipe at point 1 the partial pressure *pA1* of He is 0.6 atm and at the other end 0.2 m *pA2* is 0.2 atm. Calculate the flux of He, at steady state if *DAB* of the He-N2 mixture is 0.687 x 10-4 m2/s. | CO1 | A | 8 |
|  | b. | An evaporator is operating at atmospheric pressure. It is desired to concentrate a feed from 10% solute to 25% solute (by weight) at a rate of 4000 kg/h. Dry saturated steam at a pressure corresponding to the saturation temperature of 399 K (126oC) is used. The feed is at 298 K (25oC) and the boiling point rise (elevation), i.e., B.P.E. (B.P.R.) is 5 K. The overall heat transfer coefficient is 2350 W/(m2·K). Calculate the economy of the evaporator and the area of heat transfer to be provided. (Data: Latent heat of condensation of steam at 399 K is 2185 kJ/kg and latent heat of vaporization water at 373K is 2257 kJ/kg. Specific heat of feed is 4.187 kJ/kg.K). | CO4 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | 1100 m3/h of a gas mixture containing 10 mole % solute and rest inert enters an absorber at 250 K temperature and 106.658 kPa pressure. 90% of the original solute is removed. Solute-free water used for absorption contains 5 mole % solute when it leaves the absorber from the bottom. Calculate the solvent flow rate to the absorber. | CO5 | A | 8 |
|  | b. | Explain the process of membrane concentration, polarization, and different membrane configurations. | CO6 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Explain the principle, working mechanism, and applications of various membrane separation processes, including reverse osmosis, nano filtration, ultrafiltration, and microfiltration. Also, compare their separation efficiency and industrial uses. | CO6 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the basic concepts involved in the mass transfer process. |
| CO2 | Interpret the mass transfer phenomena in various solid-liquid separation processes. |
| CO3 | Examine the different techniques for extraction of active components. |
| CO4 | Analyze the material balance in food processing operations. |
| CO5 | Appraise the separation mechanism and performance of different equipment. |
| CO6 | Categorize the separation based on membranes. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **20FP3002** | **Duration** | **3hrs** |
| **Course Title** | **TECHNOLOGY OF FOOD FLAVOURANTS AND COLOURANTS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the different types of taste perceived in food systems. | CO1 | U | 8 |
|  | b. | Examine the various flavor potentiators used in the food industry. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | Write the process of piperine extraction from black pepper. | CO2 | A | 8 |
|  | b. | Differentiate between batch and continuous process. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 3. | a. | Examine the role of acylated ring substituted anthocyanins in food systems. | CO3 | A | 8 |
|  | b. | Compare and contrast the different methods used for the extraction of annatto with the aid of diagrams. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Illustrate the working mechanism of solid-phase microextraction static headspace analysis. | CO4 | A | 8 |
|  | b. | Describe the construction and working of SAFE. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Examine the type of core, examples and potential benefit of micro and nano encapsulation. | CO5 | A | 8 |
|  | b. | Explain the coacervation encapsulation technique used in food industry. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 6. | a. | Compare the various colour coordinate systems used in food color measurement. | CO1 | U | 8 |
|  | b. | Examine the flavor changes during baking. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | Explain the structure of Heam and extraction with organic solvents. | CO3 | An | 8 |
|  | b. | Explain the application of flavors in SCFE. | CO2 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Examine the sensory testing environment in the sensory analysis of foods. | CO6 | A | 10 |
|  | b. | Write the various test protocol considerations for panelist in food sensory analysis. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recognize the basics of flavours and colours and their safety aspects |
| CO2 | Understand the correlation between appearance and taste |
| CO3 | Develop methods for stabilization of flavourants and colourants |
| CO4 | Assess the quality of a food based on flavaourants and colourants |
| CO5 | Develop a new range of flavorants and colorants |
| CO6 | Design new techniques for analysis of colorants and aroma chemicals |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20FP3006** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCES IN FOOD PROCESS ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the principles and methods of thermal processing. | CO1 | U | 8 |
|  | b. | A specific culture containing 1200 spores/ml is divided among several containers and is subjected to a temperature 245° F for different time up to 60 min. The number of survivors/ml is given below upto 60 min.  Time (min) 0 10 20 30 40 50 60  Spores/ml 1200 500 100 20 9 4 0.5  Plot the data in a graph sheet and find out the D value and K value. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | Illustrate the principle, construction and working of freeze-drying process. | CO2 | U | 8 |
|  | b. | Food with an initial moisture content of 400% (dry-weight basis) is poured into 0.5 cm layers in a tray placed in a freeze drier operating at 40 Pa. It is to be dried to 10% moisture (dry-weight basis) at a maximum surface temperature of 55ºC. Assuming that the pressure at the ice front remains constant at 78 Pa, estimate (a) the drying time and (b) the drying time if the layer of food is increased to 0.9 cm and dried under similar conditions. (Additional data: the dried food has a thermal conductivity of 0.03 W/m K, a density of 470 kg /m3, a permeability of 2.4 x10-8 kg/s and the latent heat of sublimation is 2.95 x 103 kJ/ kg.) | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. |  | Explain the various design aspects, applications, merits and demerits of spray dryer with a suitable diagram. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 4. | a. | Write a detailed note on the development of lipid-based delivery system used to encapsulate nutraceuticals and functional foods. | CO4 | C | 8 |
|  | b. | Interpret the role of Nanosized food ingredients and additives in food industry. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 5. |  | Explain the process of dairy powder manufacturing using spray dryer and drum dryer with a suitable diagram. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. |  | Calculate the lethality rate for the give kinetic data using general method and Improved general method. The TDT is characterized by a Fo (at 121.1°C) of 2.52 min with a z value of 10°C.  **Time (min):** 0, 5,10,15,20,25,30,35,40,45,50,55,60,65,70,75,80,85& 90  **Temperature(ºC):** 60,65,70,78,86,93,102,110,115,118,120,121,121,118,111,101,85,74 &60. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Classify the hybrid drying technologies and explain any two of them. | CO3 | A | 8 |
|  | b. | For the evaluation of pasteurization process, it is recommended to utilize F value based on a reference temperature of 70°C and a Z value of 7°C. For the evaluation of cooking process and other chemical changes that occur during processing the recommended reference temperature of 100°C and Z value 30°C. Calculate the pasteurization and cooking value of following constant temperature process.   |  |  |  | | --- | --- | --- | | Process | Temperature (°C) | Time, (s) | | A | 80 | 15 | | B | 95 | 5 | | C | 70 | 145 | | D | 112 | 223 | | CO1 | E | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Critically analyze the working principle of e- nose. | CO6 | An | 10 |
|  | b. | Summarize the role of bio-catalyst in food processing industries. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the role of time – temperature combination of food processing. |
| CO2 | Explain the significance of low temperature food preservation. |
| CO3 | Identify the appropriate drying methods for specific food. |
| CO4 | Develop modified food structures and textures. |
| CO5 | Demonstrate the methods for making food powders. |
| CO6 | Construct need based biosensors for enhancing safety and quality of foods. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20FP3011** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCES IN DAIRY, MEAT AND FISH**  **PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | **Evaluate** the significance of 'Specific Gravity' as a quality control test for milk. | CO1 | **E** | 8 |
|  | b. | **Compare** the applications of Rennet and Lactase in the dairy industry. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 2. | a. | **Explain** the construction and working principle of a centrifugal cream separator. | CO2 | U | 8 |
|  | b. | **Explain** the theory of homogenization and its impact on milk properties. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | **Analyze**the impact of post-mortem biochemical changes on meat quality and tenderness. | CO3 | An | 8 |
|  | b. | **Differentiate** between white and red meat based on their muscle structure and biochemical composition. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | **Design** a modern abattoir layout that ensures meat hygiene and quality. | CO4 | C | 8 |
|  | b. | **Critique** the operational factors during carcass processing that affect the final quality of meat. | CO4 | **E** | 8 |
|  |  |  |  |  |  |
| 5. | a. | **Formulate** a production method for an intermediate moisture meat product. | CO5 | **C** | 8 |
|  | b. | **Design** a basic HACCP plan for the production of cooked sausages, identifying at least three Critical Control Points (CCPs). | CO5 | C | 8 |
|  |  |  |  |  |  |
| 6. | a. | **Explain** the changes that occur in fish during storage in Refrigerated Sea Water (RSW). | CO6 | U | 8 |
|  | b. | **Assess** the merits and demerits of using Individual Quick Freezing (IQF) versus block freezing for shrimp. | CO6 | An | 8 |
|  |  |  |  |  |  |
| 7. | a. | **Categorize** the major contaminants found in raw milk and identify their sources. | CO1 | An | 8 |
|  | b. | **Compare** the principles behind the LTLT and HTST pasteurization methods. | CO2 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | **Explain** any TWO of the following:   * + (i) Use of Liquid Nitrogen in Fish Preservation   + (ii) Canned Meat Processing   + (iii) Good Manufacturing Practice (GMP) in a Meat Plant | CO6 | U | 10 |
|  | b. | **Diagnose** a case of premature souring in pasteurized milk by analyzing the potential reasons and proposing corrective measures. | CO2 | E | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the precautions that need to be taken while handling products from this segment. |
| CO2 | Recall the different types of meat, poultry and fish and the processes involved in their  processing. |
| CO3 | Analyse the challenges in developing new value-added products from this segment. |
| CO4 | Evaluate the hygienic and safe handling of Meat, Fish and Dairy Products |
| CO5 | Design the machinery involved in the Meat, Fish and Dairy Products processing segment |
| CO6 | Create solutions for quality checks involved in Meat, Fish and Dairy Products processing  segment. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20FP3014** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCES IN REFRIGERATION AND COLD SUPPLY CHAIN MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Recall and write the desirable properties of refrigerants. | CO1 | R | 8 |
| b. | Illustrate the practical vapor absorption refrigeration systems with sketches. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Classify air conditioning systems based on various seasons and state their merits and demerits. | CO2 | An | 10 |
| b. | A wall of 0.5 m thickness is constructed using a material having a thermal conductivity of 1.4 W/ (m·K). The wall is insulated with a material having a thermal conductivity of 0.35 W/ (m·K) so that heat loss per m2 is 1500 W. The inner and outer temperatures are 1273 K (1000°C) and 373 K (100°C), respectively. Calculate the thickness of insulation required and the temperature of the interface between two layers. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 3. |  | Explain the function and applications of Controlled Atmospheric Storage (CAS) for the storage of fruits and vegetables. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. |  | Describe the various chilling equipment and the significance of secondary refrigerants. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 5. |  | Explain in detail the various freezing equipment used in food industries. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. |  | A cold storage plant is required to store 20 tonnes of fish. The temperature of the fish when supplied = 25°C; storage temperature of fish required = – 8°C; specific heat of fish above freezing point = 2.93 kJ/kg°C; specific heat of fish below freezing point = 1.25 kJ/kg°C. freezing point of fish = – 3°C. Latent heat of fish = 232 kJ/kg. If the cooling is achieved within 8 hours; determine:  (i) Capacity of the refrigerating plant.  (ii) Carnot cycle C.O.P. between these temperature ranges.  (iii) If the actual C.O.P. is 1/3 rd of the Carnot C.O.P. Calculate the power required to run the plant. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 7. | a. | Report various heat load calculations for the cold storage of fruits and vegetables. | CO4 | A | 10 |
| b. | Predict various criteria to be considered for the design of cold storage units. | CO4 | An | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Reproduce the components of cold chain management. | CO6 | R | 10 |
| b. | Examine the cold chain management principles practiced in beverages industries. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Interpret the concepts and functions of various refrigeration systems. |
| CO2 | Illustrate the working of an air conditioning system for the storage of agricultural produce. |
| CO3 | Design and construct cold storage units for perishable products. |
| CO4 | Apply advanced chilling and freezing techniques in food processing. |
| CO5 | Examine the food safety aspects of chilled foods and frozen foods. |
| CO6 | Develop cold chain management systems for transporting food products in the distribution sector. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20FP3022** | **Duration** | **3hrs** |
| **Course Title** | **FOOD SUPPLY CHAIN MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Differentiate between the inbound and outbound logistics in food supply chain management. | CO1 | An | 8 |
|  | b. | Compare third-party logistics with fourth-party logistics. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 2. | a. | Describe the various distribution channel systems in food supply chain management. | CO3 | U | 8 |
|  | b. | Write the concept of ERP and its impact on food supply chain management operations. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Distinguish between the export and import procedures and documentation. | CO5 | An | 8 |
|  | b. | Summarize the role of EIC and EIA. | CO6 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the various drivers involved in supply chain performance. | CO1 | A | 8 |
|  | b. | Classify the inventory management strategies with examples. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Describe the types of third-party logistics providers with examples. | CO3 | U | 8 |
|  | b. | Compare the advantages and disadvantages of using metal packaging with plastic packaging. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the role of global logistics providers in international supply chains. | CO5 | A | 8 |
|  | b. | Write a short note on E-food management. | CO6 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | Summarize the quantitative demand forecasting. | CO2 | U | 8 |
|  | b. | Compare the functionality of bar-coding systems with that of GPS in food supply chain management, and illustrate their roles with examples. | CO4 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Describe the food supply chain management process using a specific example, highlighting the roles and significance of each key participant. | CO6 | U | 10 |
|  | b. | Explain the need for a temperature-controlled supply chain in the food supply chain with an example. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Learn the methods of logistics. |
| CO2 | Understand the concepts of supply chain management. |
| CO3 | Identify challenges of food retailing as well as international food supply chains. |
| CO4 | Empower the students in the field of logistics and supply chain management. |
| CO5 | Design logistics and supply chain management for food industries. |
| CO6 | Apply Methods and Tools for creating sustainable supply chains. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3001** | **Duration** | **3hrs** |
| **Course Title** | **FOOD CHEMISTRY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Differentiate ‘free water’ from ‘bound water’ with examples. | CO1 | An | 10 |
|  | b. | Explain the role of water activity in microbial growth. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the mechanism of starch gelatinization and its impact on food texture. | CO2 | U | 10 |
|  | b. | Differentiate ‘amylose’ from ‘amylopectin’. | CO2 | An | 10 |
|  | | | | | |
| 3. | a. | Explain the classification and structure of lipids. | CO3 | U | 10 |
|  | b. | Explain the principle of hydrogenation of oils. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Differentiate ‘fibrous proteins’ and ‘globular proteins’. | CO4 | An | 10 |
|  | b. | Explain the importance of enzymes in food processing. | CO4 | U | 10 |
|  | | | | | |
| 5. | a. | Describe vitamin bioavailability and its influencing factors. | CO5 | U | 10 |
|  | b. | Explain the role of minerals in metabolic functions. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the structural differences between monosaccharides, disaccharides, and polysaccharides. | CO1 | An | 10 |
|  | b. | Compare the properties of native and modified starch. | CO2 | An | 10 |
|  | | | | | |
| 7. | a. | Compare the stability of hydrogenated oils with that of natural oils. | CO3 | An | 10 |
|  | b. | Explain the concept of denaturation and coagulation in proteins. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the effect of pH on pigment stability. | CO6 | U | 10 |
|  | b. | Explain the function of calcium in bone metabolism. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Differentiate ‘natural colorants’ from ‘synthetic colorants’. | CO6 | An | 10 |
|  | b. | Explain how betalain differ chemically from anthocyanin. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the general chemical structures of major components of foods (water, proteins, carbohydrates, and lipids) and selected minor components (vitamins and minerals). |
| CO2 | Understand, plan, perform and analyze a range of chemical investigations with emphasis on food analysis. |
| CO3 | Demonstrate the ability to relate the chemical composition of foods to their functional properties. |
| CO4 | Examine a molecular rationalization for the observed physical properties and reactivity of major food components. |
| CO5 | Evaluate and determine the approaches that may be used to control the reactivity of those food components that are likely to impact the overall quality of finished products. |
| CO6 | Predict how changes in overall composition are likely to change the reactivity of individual food components. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3003** | **Duration** | **3hrs** |
| **Course Title** | **PRINCIPLES OF FOOD PRESERVATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Summarize the history of food processing and preservation with a timeline on major innovations. | CO1 | U | 10 |
|  | b. | Outline the process of blanching with special emphasis on factors that affect blanching time, mechanism and equipment. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Interpret the phenomenon of hurdles in hurdle technology and its applications in food preservation. | CO2 | A | 10 |
|  | b. | Summaries the process of pasteurization with emphasis on mechanism equipment and application. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. |  | Explain the working of a drum drying system. Characterize drum dryers based on feed mechanism and draw neat sketch of each working system. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the functioning of a spray drier with a neat diagram. Enumerate the advantages of this system of drying. | CO3 | U | 10 |
|  | b. | Describe the use of dielectric heating systems in food preservation context. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Describe the phenomenon of fluidization and its application in the working of a fluidized bed dryer. Characterize food powders based on fluidization quality using a neat sketch. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Identify a unit operation that is versatile in terms of product output and w.r.t combination of various operations in one system. Elaborate on its principle, mechanism and application with neat diagrams. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Interpret the phenomenon of sublimation and its applications in freeze drying systems. | CO5 | A | 10 |
|  | b. | Summarise the application of a High Hydrostatic Pressure processing system in the food industry. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate the working of a pulsed light equipment used in food preservation. Enumerate the various processing and product parameters that have to be taken into account while designing the system. | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Interpret the parts of a power ultrasound wave and enumerate any 5 mechanical, physical and biochemical changes in foods due to the application of ultrasound waves. | CO6 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic principles involved in food preservation. |
| CO2 | Understand the various processing methods. |
| CO3 | Comprehend suitable techniques for the preservation of various foods. |
| CO4 | Apply the modern technologies of food preservation in industry. |
| CO5 | Analyze the conventional and novel preservation techniques. |
| CO6 | Evaluate and suggest proper preservation methods and equipment. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3004** | **Duration** | **3hrs** |
| **Course Title** | **TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Illustrate the structure of wheat with a neat sketch. | CO1 | U | 10 |
|  | b. | Explain the various causes of grain losses and their preservation techniques. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Sketch the various steps of milling in detail. | CO2 | A | 10 |
|  | b. | Describe the various by-products of wheat. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the use of Alveographs in determining the quality of wheat. | CO3 | An | 10 |
|  | b. | What would be the operating speed of rotation in revolutions per minute of a ball mill of 2,000 mm diameter charged with 100 mm balls? The ball mill is grinding solid matter. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the effect of parboiling on milling and cooking qualities. | CO2 | An | 10 |
|  | b. | Demonstrate the CFTRI method of paddy parboiling. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the manufacturing process of flaked rice with a flowchart. | CO2 | U | 10 |
|  | b. | Outline the commercial production of High Fructose Corn Syrup. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the causes of favism in plant with main food source and toxicity symptoms. | CO4 | U | 10 |
|  | b. | Explain the production of Isolated Soybean Protein (ISP) | CO5 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the production of breakfast cereals from maize. | CO4 | U | 10 |
|  | b. | Compare the various methods of production of quick cooking rice. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Examine the sources and show the mode of action of hemagglutinins. | CO5 | A | 10 |
|  | b. | Describe the wet milling of pulses with a flow diagram. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Examine the various advantages and disadvantages of ghani crushing. | CO6 | U | 10 |
|  | b. | Demonstrate the various methods of oil extraction. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic concept of cereals, pulses and oil seeds processing. |
| CO2 | Understand the various unit operations involved in milling. |
| CO3 | Analyze and select suitable equipment for milling. |
| CO4 | Apply the knowledge to process grains into value-added products. |
| CO5 | Create new products from pulses and legumes. |
| CO6 | Gain knowledge on converting the waste into wealth. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3005** | **Duration** | **3hrs** |
| **Course Title** | **TECHNOLOGY OF FRUITS AND VEGETABLE PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Summarize the methods to extend the shelf life of fruits and vegetables. | CO1 | U | 10 |
|  | b. | Analyze the future scope for fruit and vegetable processing industries in India. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate cryogenic pre-cooling of strawberries. | CO1 | U | 10 |
|  | b. | Explain vacuum cooling for leafy vegetables along with the line diagram. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Develop the process of aseptic processing of pomegranate juice. | CO5 | A | 10 |
|  | b. | Explain the potential advantages and disadvantages in CAS. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | State the objectives of blanching and its advantages. | CO2 | R | 10 |
|  | b. | Enlist different types of peeling and explain lye peeling in detail. | CO1 | R | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain in detail about Active packaging and enlist active ingredients used in active packaging. | CO5 | U | 10 |
|  | b. | Design a conceptual flow diagram for a hybrid concentration system that uses multi-effect evaporation for vegetable purees. | CO5 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Differentiate evaporation from freeze concentration as concentration techniques used for carrot puree. | CO5 | An | 10 |
|  | b. | Explain in detail about modified atmosphere packaging of mushrooms. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the processing steps involved in canning of sweet corn kernels. | CO5 | U | 10 |
|  | b. | Differentiate ‘active MAP’ from ‘passive MAP’. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the mechanism of osmotic dehydration of orange slices. | CO2 | U | 10 |
|  | b. | Draw the technological processing flowchart for the RTS production and give FSSAI specifications. | CO4 | C | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Design a technological processing flow chart and elaborate on the pickling process. | CO6 | C | 10 |
|  | b. | Identify the defects and their respective remedies in jam processing. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge of different physical, chemical and nutritional properties of fruits and vegetables. |
| CO2 | Acquire insight into the various chemical and biochemical changes that occur during processing. |
| CO3 | Learn various ways of designing and monitoring processing chains |
| CO4 | Gain thorough knowledge about laws, regulations and the monitoring agencies involved in food safety and labeling of fruits and vegetables. |
| CO5 | Understand the methods of packaging, shelf life and related factors in the processing of fruits and vegetables. |
| CO6 | Know how fruits and vegetables are processed in industries. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3009** | **Duration** | **3hrs** |
| **Course Title** | **NUTRITION AND METABOLISM** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Write in detail the anthropometric and biochemical assessment methods used to evaluate nutritional status. | CO1 | R | 10 |
|  | b. | Explain in detail the processes of digestion and absorption of carbohydrates in the human body. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the types and nutritional management of Jaundice and Hepatitis. | CO2 | U | 10 |
|  | b. | Describe the genetic causes of protein metabolism disorders and their dietary management. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain gluconeogenesis in detail with a flowchart. | CO3 | U | 10 |
|  | b. | Discuss the role of the TCA cycle in carbohydrate metabolism with a flow diagram. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the process of fatty acid degradation with a flowchart. | CO4 | A | 10 |
|  | b. | Differentiate the role cholesterol in membrane integrity and physiological functions. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate cysteine metabolic pathways through a detailed flow chart | CO5 | U | 10 |
|  | b. | Illustrate phenylalanine metabolic pathways through a detailed flow chart | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the role of nutrition in managing and preventing hypertension. | CO6 | U | 10 |
|  | b. | Explore the relationship between nutrition, the aging process and longevity. | CO6 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain micronutrient deficiencies and nutrition strategies to prevent osteoporosis. | CO1 | U | 10 |
|  | b. | Describe the challenges and important considerations in pediatric nutrition. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the nutritional requirements during pregnancy and the impact of maternal nutrition on fetal development. | CO5 | R | 10 |
|  | b. | Explain the role of nutrition in the prevention and management of diabetes. | CO6 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the significance of dietary guidelines for sports performance and recovery. | CO6 | A | 10 |
|  | b. | Discuss dietary considerations and concerns for individuals at high altitudes. | CO6 | R | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of nutrition and metabolism of the major macromolecules. |
| CO2 | Describe the biochemistry process, the basic concept of human nutrition, and the relationship of the consumption of foods to nutritional status and health. |
| CO3 | Apply their knowledge in food biochemistry and nutrition in designing a new range of products with improved nutritional characteristics. |
| CO4 | Analyze the stages in the catabolism of food molecules and describe what occurs during each stage. |
| CO5 | Evaluate the biological functions of foods for health in addition to nutritional values. |
| CO6 | Formulate specialized nutrition for pediatric, geriatric, and sport’s needs. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3011** | **Duration** | **3hrs** |
| **Course Title** | **INSTRUMENTAL METHODS OF ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Illustrate the gas chromatography (GC) with a labelled diagram. | CO1 | U | 10 |
|  | b. | Explain the high-performance liquid chromatography (HPLC) with a labelled diagram and the advantages of HPLC over other chromatography techniques. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the type of gas chromatography (GC) and its applications. | CO1 | U | 10 |
|  | b. | Describe the working principle of mass spectrometry and its applications. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the principle of Infrared (IR) spectroscopy and its major components with a labelled diagram. | CO2 | U | 10 |
|  | b. | Describe the Nuclear Magnetic Resonance (NMR) spectroscopy with a labelled diagram and its applications. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe the Near Infrared spectroscopy (NIR) and its applications. | CO2 | U | 10 |
|  | b. | Explain the types of molecular vibrations and relate them to vibrational frequencies and corresponding IR absorption bands. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the working mechanism and applications of chemical sensors (chemosensors) in food quality assessment. | CO6 | U | 10 |
|  | b. | Describe the principles, components, and applications of biosensors in detecting foodborne pathogens or contaminants. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate the inductively coupled plasma atomic emission spectroscopy (ICP - AES) with a labelled diagram, including its applications and limitations. | CO3 | E | 10 |
|  | b. | Describe the principle of conductometry, its main parts with a labelled diagram, and its applications. | CO6 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Describe the concepts of chemical shift, shielding, and deshielding effects in Nuclear Magnetic Resonance (NMR) spectroscopy*.* | CO4 | U | 10 |
|  | b. | Explain the principle and procedure involved in the determination of bicarbonate ion concentration (pHCO₃⁻) using potentiometric methods. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the types of electrophoresis with suitable examples. | CO6 | U | 10 |
|  | b. | Describe the principle and working mechanism of the water activity meter and its applications. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate the Transmission Electron Microscope (TEM) with a labelled diagram, and its applications. | CO5 | U | 10 |
|  | b. | Describe the principle, instrumentation, and working of dynamic light scattering (DLS) along with its applications. | CO5 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Recognize the components of the mixture using chromatographic techniques |
| CO2 | Identify the functional groups present in the food sample |
| CO3 | Calculate the trace metals present in the food sample |
| CO4 | Analyze the structure of the novel compound isolated from natural source |
| CO5 | Assess the molecular weight of the given component |
| CO6 | Organize components from mixture based on electrical property |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3018** | **Duration** | **3hrs** |
| **Course Title** | **FOOD PACKAGING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Analyze the intrinsic and extrinsic factors that affect the quality of the food. | CO1 | An | 10 |
|  | b. | Explain the accelerated shelf-life test (ASLT) process and its various phases. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the basic functions and requirements of the packaging. | CO1 | U | 10 |
|  | b. | Compare the various mechanical methods to test the packaging materials. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Apply the blow and blow technique to produce a narrow-neck glass bottle design. | CO3 | A | 10 |
|  | b. | Discuss the methodology of annealing, hot-end, and cold-end treatment given to glass containers. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the manufacturing process of 3-piece cans. | CO3 | A | 10 |
|  | b. | Explain why interior coatings are important in metal cans and also write the essential requirements for an interior coating. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the characteristics of all common types of plastics used in the food industry. | CO5 | U | 10 |
|  | b. | Compare and contrast the merits and demerits of various plastic molding process. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Examine how each section of the paper-making machine influences the paper's final characteristics. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Design a label for a frozen chicken sausage package; state the labeling information that is to be put up to meet consumer needs. | CO5 | C | 10 |
|  | b. | Explain the working principle of vertical form fill machine. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain any two major types of labels used for foods and list the minimum information required on a label. | CO5 | U | 10 |
|  | b. | Explain volumetric cup filling method with a neat sketch. | CO4 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the principle of Radio Frequency Identification (RFID) tags and the various benefits of using RFID technology in food packaging. | CO6 | U | 10 |
|  | b. | Explain the concept of Modified Atmospheric Packaging. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the need and functions of packaging to protect and store food. |
| CO2 | Gain knowledge on the shelf life of food and accelerated shelf-life testing. |
| CO3 | Know the different packaging materials based on their properties and their application. |
| CO4 | Learn about the filling and sealing techniques used for different food materials. |
| CO5 | Understand labeling methods and legislature. |
| CO6 | Know about the advanced food packaging techniques. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3019** | **Duration** | **3hrs** |
| **Course Title** | **FOOD ADDITIVES AND INGREDIENTS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the key labelling requirements for food additives with relevant examples. | CO1 | An | 10 |
|  | b. | Classify food additives according to their functional roles in food, providing examples for each category. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Differentiate between the major types of food preservatives based on their mechanisms of action and permitted limits in food products. | CO2 | An | 10 |
|  | b. | Explain the mechanism by which acidulants preserve foods through pH reduction, with **ANY FOUR** examples. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Compare natural and synthetic antioxidants used in foods with examples. | CO3 | An | 10 |
|  | b. | Describe the principle of metal ion sequestration and give examples of common sequestrants used to prevent oxidation in foods. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Differentiate between nutritive and non-nutritive sweeteners used in foods, citing appropriate examples for both types. | CO4 | A | 10 |
|  | b. | Explain the classification and production pathways of nature-identical flavouring agents, highlighting examples. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain and diagrammatically represent the steps in the production of betalains. | CO5 | A | 10 |
|  | b. | Describe the mandatory labelling guidelines for natural and synthetic colourants in packaged foods, providing illustrative examples. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Compare the roles of nucleotides and MSG as flavour enhancers, highlighting their contribution to the umami taste in foods. | CO4 | U | 10 |
|  | b. | Explain the mode of action of synthetic antioxidants with their structures, highlighting their role in inhibiting lipid oxidation in foods. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the mechanisms of preservatives to prevent meat spoilage and give one example to support your answer. | CO2 | An | 10 |
|  | b. | Describe the concept of E numbers in EU food additive labelling, outlining E numbers for various classes of food additives. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the roles of bleaching and maturing agents in flours with examples. | CO6 | U | 10 |
|  | b. | Explain the positive and negative health impact of natural and synthetic food colorants. | CO5 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Compare oil-in-water and water-in-oil emulsions with appropriate examples. | CO6 | An | 10 |
|  | b. | Explain the role of carbohydrate-based fat mimetics in food products. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Recognize the importance of additives in maintaining or improving food quality. |
| CO2 | Demonstrate and relate the level of addition of food additives to its quality. |
| CO3 | Understand the applications of food additives and methods to study their permissible limits. |
| CO4 | Categorize and choose the appropriate additive depending on the type of food. |
| CO5 | Identify and design newer products, with better quality using additives that are economical and safe. |
| CO6 | Develop a new range of additives that are multifunctional and safe. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3021** | **Duration** | **3hrs** |
| **Course Title** | **WATER AND FOOD WASTE RESOURCE MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the challenges involved in waste characterization obtained from food industry. | CO1 | U | 10 |
|  | b. | Determine the key steps for initiating a waste characterization study at a fruit cannery. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain all the four phases of bio gas generation along with reactions. | CO2 | U | 10 |
|  | b. | Summarize the major sources of waste from fruits and vegetables Industries. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Design a composting system for a university cafeteria that utilizes the aerated static pile method. Specify the key components and operational parameters to ensure efficient food waste processing. | CO3 | C | 10 |
|  | b. | Illustrate anaerobic compositing methods. Enlist the advantages and disadvantages OF anaerobic composting. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the trickling filters in detail with its process diagram. | CO4 | U | 10 |
|  | b. | Compare the waste characterization profiles of waste water generated from a dairy plant and a vegetable cannery. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain activated sludge systems along with diagram. | CO5 | U | 10 |
|  | b. | Draw a diagram for dissolved air flotation (DAF) system and explain its working. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | A food processing plant's existing wastewater treatment system is failing to meet discharge limits. Implement the concept of a Rotating Biological Contactor (RBC) by preparing a design proposal. | CO2 | C | 10 |
|  | b. | Discuss seafood-processing wastewater characterization by its various physiochemical parameters. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Categorize the key bio-products obtainable from fruit and vegetable skins, grouping them based on their chemical nature (e.g., polysaccharides, phenolics, enzymes) or their industrial sector. | CO4 | An | 10 |
|  | b. | Explain the primary treatment of the waste water obtained from Dairy processing unit. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the major sources of pollution load in fruit and vegetable processing industries. | CO3 | U | 10 |
|  | b. | Summarize the legal framework governing waste management in urban and peri-urban regions, focusing on the duties of municipal authorities and waste generators. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain a case study along with the calculation for water foot print for the poultry processing unit. | CO6 | C | 10 |
|  | b. | Develop a standard operating procedure (SOP) for the ultrafiltration and diafiltration steps in the production of whey protein isolate (WPI) from cheese whey. | CO4 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Identify sources of potable water. |
| CO2 | Identify the origin of waste generated in food industries. |
| CO3 | Summarize various methods of treating water and food wastes. |
| CO4 | Demonstrate co-product recovery from food waste. |
| CO5 | Decide on suitable food waste resources management strategies. |
| CO6 | Develop pollution prevention mechanisms. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22FT3024** | **Duration** | **3hrs** |
| **Course Title** | **ENZYMES IN FOOD PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain in detail about the general terminology and nomenclature of enzymes | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Distinguish between protein nature of enzymes with non-protein nature of enzymes in detail. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Discuss in detail about the cofactors and coenzymes. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain in detail about the types of enzyme inhibition. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain in detail about the kinetics of single substrate enzyme in Catalysed reaction | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain in detail about the feedback regulation and allosteric regulation. | CO5 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Classify the membranes present in enzymes in detail. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain in detail about the industrial enzymes in thermophilic enzymes and amylases. | CO6 | An | 20 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain in detail about the proteolytic enzymes in food industries. | CO6 | An | 20 |
|  |  |  |  |  |  |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the structure, functions, and mechanisms of action of enzymes. |
| CO2 | Understand the enzyme activity in foods. |
| CO3 | Learn kinetics of enzyme-catalyzed reactions and enzyme inhibitory and regulatory processes. |
| CO4 | Understand immobilization of enzymes. |
| CO5 | Apply the acquired skills to the applications of enzymes and their future potential. |
| CO6 | Evaluate the application of various enzymes at the industry level |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2001** | **Duration** | **3hrs** |
| **Course Title** | **BASICS OF MICROBIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the scientist known as the father of microbiology. | | CO1 | R | 1 |
| 2. | State the years that mark the beginning and end of the golden age of microbiology. | | CO1 | R | 1 |
| 3. | Define the term strain. | | CO2 | R | 1 |
| 4. | List any two morphological characteristics of microbes used for classification. | | CO2 | R | 1 |
| 5. | Define the term prokaryotic cells. | | CO3 | R | 1 |
| 6. | Define the bacteria. | | CO3 | R | 1 |
| 7. | List the any two examples of cultral media based on consistancy. | | CO4 | R | 1 |
| 8. | State the full form CFU. | | CO5 | R | 1 |
| 9. | Define the term lag pahse. | | CO5 | R | 1 |
| 10. | State the meaning of sterilization. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Summarize the Robert Koch postulates (assumption) used to prove the cause of an infectious disease. | | CO1 | U | 3 |
| 12. | List the molecular characteristics to classify the microbes. | | CO2 | R | 3 |
| 13. | State the general characteristics of fungi. | | CO3 | R | 3 |
| 14. | State the importance of various nutrients essential for microbes. | | CO4 | R | 3 |
| 15. | Explain the advantages and limitations direct microscopic count. | | CO5 | U | 3 |
| 16. | Discuss the ideal characteristic of chemical sterilization. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Discuss how discoveries from the golden age of microbiology shaped the modern understanding of microorganisms. | CO1 | U | 6 |
|  | b. | Explain the importance microbiology in agriculture, industry, and environmental filed. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the physiological and metabolic characteristics for microbial classification. | CO2 | U | 6 |
|  | b. | Explain the phenotypic and phylogenetic classification of microbes. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the main structural components of a bacterial cell with their functions. | CO3 | U | 6 |
|  | b. | Describe the major stages in the life cycle of red algae (*Gracilaria).* | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the typical bacterial growth curve in a batch culture with labelled diagram. | CO4 | A | 6 |
|  | b. | Discusses the culture media based on their nutritional component. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe the standard plate count (viable counts) for microbial enumeration. | CO5 | U | 6 |
|  | b. | Explain the streak plate method microbial identification. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain mechanism of moist heat sterilization along with its applications. | CO6 | A | 6 |
|  | b. | Describe the mechanism of liquid method for sterilization. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate general structure of animal viruses (Adenovirus) and its replication process inside a host cell. | CO3 | U | 6 |
|  | b. | Illustrate the electron microscope with labelled diagram. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain in detail the various physical and chemical methods employed for sterilization in microbiology. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the historical development in the field of Microbiology. |
| **CO2** | Summarize the classification of microorganisms. |
| **CO3** | Interpret the parts of prokaryotic and eukaryotic cells and their functions. |
| **CO4** | Select a suitable bacteriological media for the growth of bacteria. |
| **CO5** | Apply the methods used for enumeration, identification and preservation of bacteria. |
| **CO6** | Distinguish between physical and chemical sterilization techniques |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23FP2003** | **Duration** | **3hrs** |
| **Course Title** | **FOOD PROCESS CALCULATIONS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define a derived unit and give one example. | | CO1 | R | 1 |
| 2. | Indicate the dimensional formula of force. | | CO1 | U | 1 |
| 3. | State Dalton’s law of partial pressures. | | CO2 | R | 1 |
| 4. | Identify one condition under which real gases deviate from ideal gas behavior. | | CO2 | U | 1 |
| 5. | Define by-pass operation. | | CO3 | R | 1 |
| 6. | List the major inputs and outputs in an evaporation process. | | CO3 | R | 1 |
| 7. | Identify the difference between latent heat of fusion and vaporization. | | CO4 | U | 1 |
| 8. | State Kopp’s rule. | | CO4 | R | 1 |
| 9. | Express the main purpose of determining the theoretical air requirement. | | CO5 | U | 1 |
| 10. | List any two parameters represented on a psychrometric chart. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Verify the dimensional homogeneity of the equation X=ut+½ at2 where X is the length, u-initial velocity, a-acceleration and t-time. | | CO1 | An | 3 |
| 12. | Determine the volume occupied by 4 moles of an ideal gas at 1 atm and 273 K. | | CO2 | A | 3 |
| 13. | Illustrate the process flow diagram of a crystallization process showing the system boundaries with a neat sketch and construct the mass balance. | | CO3 | U | 3 |
| 14. | Define specific heat and calculate the amount of heat required to raise the temperature of 2 kg of water from 25°C to 80°C. (Given: Cp=4.18kJ/kg⋅K) | | CO4 | A | 3 |
| 15. | Define heating value and compare NHV with GHV. | | CO5 | An | 3 |
| 16. | Construct a psychrometric process diagram showing heating, cooling, humidification, and dehumidification paths, and label all important parameters. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Examine the various methods of expressing the composition of solutions and determine the following for an aqueous solution of K2CO3 containing 50% salt. The specific gravity of the solution is 1.53.  a) The mole percent of the salt in solution.  b) The volume percent of water assuming density of water is 1000 kg/m3 and there is no volume change on mixing.  c) The molality of the solution. d) The molarity of the solution.  e) The normality of the solution. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the gas laws and derive an expression for the ideal gas equation. | CO2 | An | 8 |
|  | b. | A 150 L oxygen cylinder contains gas at 300 K and 10 bar. Determine the mass of oxygen in the cylinder. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 19. |  | Apply the law of conservation of mass to develop the overall and component material balances for a drying operation. A drier is fed with wet solid containing 80% moisture (by weight) to reduce the moisture content to 15%. The product from the drier is then passed to an oven, which further reduces the moisture content to 2%. If the drier handles 1000 kg of wet solid per day, calculate the following:  a) The weight of products leaving the drier and the oven per day.  b) The percentage of the original water removed in the drier and in the oven. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Compare the heat of reaction, combustion, and formation under constant temperature and standard conditions using suitable examples. | CO4 | An | 6 |
|  | b. | Examine the Hess Law of Constant Heat Summation for a chemical reaction to determine the standard heat of reaction using heats of formation. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the systematic method for determining the composition of flue gas using the Orsat apparatus. | CO5 | U | 6 |
|  | b. | Evaluate the significance of theoretical oxygen demand and excess air in ensuring safe and complete combustion of fuels. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Analyze the deviations of real gases from ideal gas behavior using the van der Waals equation. | CO2 | An | 6 |
|  | b. | An evaporator has a rated evaporation capacity of 500 kg water/h. Calculate the rate of production of juice concentrate containing 45% total solids from raw juice containing 12% solids. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Compare the expressions for the heat capacities of solids, liquids, and gases as functions of temperature. | CO4 | An | 8 |
|  | b. | Develop a process flow diagram and construct a total and component mass balance equation for a crystallizer where 100 kg of a concentrated sugar solution containing 85% sucrose and 1% inert, water-soluble impurities (balance, water) enters. Upon cooling, the sugar crystallizes from solution. A centrifuge then separates the crystals from a liquid fraction, called the mother liquor. The crystal slurry fraction has, for 20% of its weight, a liquid having the same composition as the mother liquor. The mother liquor contains 60% sucrose by weight. | CO3 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | An air-water mixture at 101.3 kPa has a dry-bulb temperature of 303 K and is 10% saturated with water vapor. Define and determine the following properties using psychrometric chart:  a) The absolute humidity, kg water vapor per kg dry air.  b) The partial pressure of water vapor in kPa.  c) The absolute saturation humidity at 303 K, kg water vapor per kg dry air.  d) The vapor pressure of water at 303 K, kPa.  e) The percent relative saturation, %. f) The dew point temperature,°C. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Identify the compositions of mixtures and solutions. |
| **CO2** | Compare the properties of ideal and real gases. |
| **CO3** | Calculate material balance for various unit operations. |
| **CO4** | Analyze energy balance for unit operations. |
| **CO5** | Estimate GHV, NHV, and composition of fuels. |
| **CO6** | Integrate the properties of air-water system. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2004** | **Duration** | **3hrs** |
| **Course Title** | **FRUIT AND VEGETABLE PROCESSING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define senescence. | | CO1 | R | 1 |
| 2. | List the micronutrients in fruits. | | CO1 | U | 1 |
| 3. | Define drying. | | CO2 | R | 1 |
| 4. | List the methods of grading fruits. | | CO2 | U | 1 |
| 5. | Remember canning. | | CO3 | R | 1 |
| 6. | Define retort processing. | | CO3 | R | 1 |
| 7. | Recall Puree. | | CO4 | R | 1 |
| 8. | List the FSSAI specification of Jam for pulp and TSS content. | | CO4 | U | 1 |
| 9. | Define HPP. | | CO5 | R | 1 |
| 10. | Expand FCI. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate climacteric and non-climacteric fruits. | | CO1 | An | 3 |
| 12. | Differentiate sorting and grading of fruits. | | CO2 | An | 3 |
| 13. | Show the factors affecting the process of canning. | | CO3 | An | 3 |
| 14. | Explain the problems involved in the jam-making process (defective jam). | | CO4 | U | 3 |
| 15. | Differentiate active and passive packaging in MAP. | | CO5 | An | 3 |
| 16. | Explain the seven principles of HACCP system. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the types and causes of post-harvest losses. | CO1 | U | 6 |
|  | b. | Compare chilling and freezing injury. |  | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the merits and demerits of drying fruits. | CO2 | U | 4 |
|  | b. | Outline the working principle of the spray drier with a neat sketch. |  | An | 8 |
|  |  |  |  |  |  |
| 19. |  | Outline the steps involved in the commercial canning of vegetables. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Describe the jelly-making process using fresh fruit. | CO4 | U | 8 |
|  | b. | Explain the preparation of candied fruits/vegetables. |  | U | 4 |
|  |  |  |  |  |  |
| 21. |  | Demonstrate the requirements for an ideal CA storage system. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Show the principle and components involved in the high-pressure processing system. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the principle and components involved in the pulsed electric field processing. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the core function of FSSAI. | CO6 | U | 8 |
|  | b. | Explain the objective of BIS. |  | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall the different physical, chemical and nutritional properties of fruits and vegetables. |
| **CO2** | Understand the post-harvest handling operations for fruits and vegetables. |
| **CO3** | Apply the knowledge of unit operations to pick specific heat treatment for processing and  preservation of fruits and vegetables |
| **CO4** | Analyse the various products and processing techniques used in manufacture of value-added fruit  products |
| **CO5** | Assess the various minimal processing techniques used in food industry. |
| **CO6** | Identify the various statutory bodies regulating food standards in India. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2005** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO FLUID MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define viscosity of a fluid. | | CO1 | R | 1 |
| 2. | Convert 1.0 stoke to m2/s. | | CO1 | U | 1 |
| 3. | List any two pressure measuring devices. | | CO2 | R | 1 |
| 4. | Write the relationship between vacuum pressure, atmospheric pressure and absolute pressure. | | CO2 | A | 1 |
| 5. | Mention the use of orifice meter. | | CO3 | R | 1 |
| 6. | State Newton’s second law of motion. | | CO3 | R | 1 |
| 7. | Express the formula for finding loss of head due to sudden contraction. | | CO4 | U | 1 |
| 8. | Identify cases of water hammering in pipes. | | CO4 | A | 1 |
| 9. | Give any two examples of pipe network system. | | CO5 | U | 1 |
| 10. | Classify the orifices based on the nature of discharge. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Derive an expression for a time period (t) of a pendulum, which depends upon length (L) and acceleration due to gravity. | | CO1 | An | 3 |
| 12. | Write short notes on pressure measuring devices. | | CO2 | U | 3 |
| 13. | Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm2 and with mean velocity of 2.0 m/s. Calculate the total head or total energy per unit weight of the water at a cross section, which is 5 m above the datum line. | | CO3 | An | 3 |
| 14. | List the different types of flow and define any three of them. | | CO4 | U | 3 |
| 15. | Calculate the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 litres/sec. | | CO5 | An | 3 |
| 16. | The head of water over the centre of an orifice of diameter 20 mm is 1m. The actual discharge through the orifice is 0.85 litre/s. Find the coefficient of discharge. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Classify fluids based on their rheological behaviour with neat diagrams. | CO1 | U | 5 |
|  | b. | Calculate the specific weight, density and specific gravity of one litre of a liquid which weighs 7N. | CO1 | A | 4 |
|  | c. | Determine the bulk modulus of elasticity of a liquid, if the pressure of the liquid is increased from 70 N/cm2 to 130 N/cm2. The volume of the liquid decreases by 0.15 percent. | CO1 | U | 3 |
| 18. | a. | Calculate the pressure due to a column of 0.3 of a) water, b) an oil of sp. gr. 0.8, and c) mercury of sp.gr, 13.6. Take density of water ρ = 1000 kg/m3. | CO2 | An | 6 |
|  | b. | A differential manometer is connected at the two points A and B as shown in the figure. At B, the air pressure is 9.81 N/cm2(abs), determine the absolute pressure at A. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Derive the three-dimensional continuity equation for a fluid element based on the principle of conservation of mass. | CO3 | C | 6 |
|  | b. | A 30cm pipe diameter conveying water, branches into two pipes of diameter 20cm and 15cm respectively. If average velocity in 30cm pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15cm pipe, if the average velocity in 20cm pipe is 2.0 m/s. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Derive the Darcy–Weisbach equation for head loss in a pipe due to friction, applying fundamental principles of fluid flow. | CO4 | C | 7 |
|  | b. | Determine the head lost due to friction in a pipe of diameter 300mm and length 50m, through which water is flowing at a velocity of 3 m/s using i) Darcy’s formula ii) Chezy’s formula for which C=60. Take kinematic viscosity (v) for water = 0.01 stoke. | CO4 | A | 5 |
|  |  |  |  |  |  |
| 21. | a. | A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1.0 m respectively, while the length and diameter of second parallel pipe are 2000 m and 0.8 m. Measure the rate of flow in each parallel pipe, if total flow in the main is 3.0 m3/s. The coefficient of friction for each parallel pipe is the same and equal to 0.005. | CO5 | E | 8 |
|  | b. | Explain the phenomenon of water hammer in pipes. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Deduce an expression for head loss in a sudden enlargement in the pipe. | CO5 | An | 7 |
|  | b. | An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives the reading of 50 cm of mercury. Estimate the rate of flow of oil of sp.gr. 0.9 when the coefficient of discharge of the orifice meter = 0.64. | CO3 | E | 5 |
|  |  |  |  |  |  |
| 23. | a. | Describe the Rayleigh’s method for dimensional analysis and derive an expression for the drag force on smooth sphere of diameter D, moving with a uniform velocity V, in a fluid of density ρ, and dynamic viscosity µ. | CO1 | R | 8 |
|  | b. | A crude oil of kinematic viscosity 0.4 stoke is flowing through a pipe of diameter 300 mm at the rate of 300 litre/s. Calculate the head loss due to friction for a length of 50 m of the pipe. | CO4 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | The head of water over an orifice of diameter 40 mm is 10 m. Estimate the actual discharge and actual velocity of the jet at vena – contracta. Take Cd = 0.6 and Cv = 0.98. | CO6 | E | 5 |
|  | b. | A circular tank of diameter 4 m contains water up to a height of 5m. The tank is provided with an orifice of diameter 0.5m at the bottom. Estimate the time taken by the water   1. To fall from 5m to 2m 2. For completely emptying the tank. | CO6 | E | 7 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the various properties of fluids and apply them in problem-solving. |
| **CO2** | Estimate the fluid pressure acting on a body. |
| **CO3** | Apply the principles of continuity equation and Bernoulli’s equation to fluid flow problems. |
| **CO4** | Calculate the head loss due to friction in viscous and turbulent flow through pipes. |
| **CO5** | Determine the minor losses through various pipes |
| **CO6** | Estimate the fluid flow through different flow measuring devices. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23FP2014** | **Duration** | **3hrs** |
| **Course Title** | **APPLIED FOOD MICROBIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify one common source of microorganisms in food. | | CO1 | U | 1 |
| 2. | List one protozoan associated with food contamination. | | CO1 | R | 1 |
| 3. | Reinstate one oriental fermented food product. | | CO2 | R | 1 |
| 4. | List one fermented food where starter cultures are used. | | CO2 | R | 1 |
| 5. | Name one psychrotrophic bacterium that causes food spoilage. | | CO3 | U | 1 |
| 6. | Recollect one fishery product commonly affected by spoilage microbes. | | CO3 | R | 1 |
| 7. | Recall one foodborne toxin caused by algae. | | CO4 | U | 1 |
| 8. | Spell out one biogenic amine harmful to humans. | | CO4 | R | 1 |
| 9. | Define pasteurization in simple terms. | | CO5 | U | 1 |
| 10. | State the full form of PCR used in food safety detection. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze how equipment and water can influence the microbiological quality of food. | | CO1 | An | 3 |
| 12. | Describe the role of starter cultures in fermented food production. | | CO2 | U | 3 |
| 13. | Analyze the differences in microbial spoilage between canned foods and fermented foods. | | CO3 | An | 3 |
| 14. | Summarize the significance of algal toxins in foodborne illnesses. | | CO4 | U | 3 |
| 15. | Analyze the correlation between thermal and non-thermal methods of food preservation. | | CO5 | An | 3 |
| 16. | Explain the principle of ELISA in detecting foodborne pathogens. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Analyze the sources of microorganisms in food and explain their impact on food quality. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the microbiology of sauerkraut fermentation. | CO2 | U | 6 |
|  | b. | Assess the benefits of probiotics and symbiotics in human health. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Differentiate microbial spoilage of milk, meat, and canned foods with suitable examples. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Compare foodborne infections and intoxications with examples of pathogens and their effects. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Investigate and compare thermal and non-thermal methods of food preservation with examples | CO5 | A | 12 |
| 22. |  | Explain the characteristics of molds, yeasts, and bacteria commonly found in foods. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the role of starter cultures in fermented food processing and their health benefits. | CO2 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Examine the different rapid methods for detecting microorganisms in food and their applications. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Identify the characteristics, sources and significance of predominant microorganisms in foods. |
| **CO2** | Express the role of beneficial microorganisms in fermented foods. |
| **CO3** | Determine the spoilage of foods by microorganisms and the strategies implemented to prevent spoilage. |
| **CO4** | Categorise the foodborne pathogens associated with intoxication and infection. |
| **CO5** | Employ suitable thermal or non-thermal modes for preservation of foods. |
| **CO6** | Analyse and apply appropriate food safety protocols. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2016** | **Duration** | **3hrs** |
| **Course Title** | **FOOD ADDITIVES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Food Safety. | | CO1 | R | 1 |
| 2. | Define LD100. | | CO1 | R | 1 |
| 3. | Identify the emulsifier that is found naturally in soyabean. | | CO2 | R | 1 |
| 4. | List ANY TWO plant-based gums. | | CO2 | R | 1 |
| 5. | Identify the humectant commonly used in salad dressing. | | CO3 | R | 1 |
| 6. | Expand DATEM. | | CO3 | R | 1 |
| 7. | Identify an example for crumb brightener. | | CO4 | U | 1 |
| 8. | Express the formula for BMI calculation. | | CO4 | R | 1 |
| 9. | Recall the average GI value for artificial sweeteners. | | CO5 | R | 1 |
| 10. | Define the term “No added sugar” as used in food labeling. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between acute oral toxicity and short-term feeding studies. | | CO1 | An | 3 |
| 12. | Explain the functions of emulsifiers. | | CO2 | U | 3 |
| 13. | List ANY THREE-enzyme supplements. | | CO3 | U | 3 |
| 14. | Classify flavors according to origin and nature of raw material. | | CO4 | U | 3 |
| 15. | List ANY THREE commercial uses of artificial sweeteners. | | CO5 | U | 3 |
| 16. | List examples of consumer organizations. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Classify the various types of food additives based on their function with appropriate examples. | CO1 | An | 6 |
|  | b. | Write short notes on regulatory bodies for Food Additives. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Show the role of emulsifier in ice cream. | CO2 | A | 6 |
|  | b. | Explain the various types of synthetic antioxidants. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the various dough conditioners with suitable examples. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Summarize the functions and toxicological aspects of any three major gums used in food products. | CO4 | An | 6 |
|  | b. | Differentiate from ‘natural antioxidants’ from ‘synthetic antioxidants’ | CO2 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the different methods for flavor production. | CO5 | U | 8 |
|  | b. | Explain the various fat-based fat replacers. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Explain the various plant-based pigments. | CO4 | U | 8 |
|  | b. | List any four factors influenced by emulsifiers in the stabilization of an emulsion. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 23. |  | Define the following terms:  (i) Reference Dose  (ii) LDLO.  (iii) TDLO  (iv) Tolerance level  (v) Maximal permissible intake per day.  (vi) NOAEL | CO1 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Outline the methods used to detect the adulterants found in sugar. | CO6 | An | 6 |
|  | b. | Discuss the function of chelating agents in food systems. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the importance of additives in maintaining or improving food quality. |
| **CO2** | Understand the applications of food additives |
| **CO3** | Employ food additives with limitations for industrial application |
| **CO4** | Distinguish the characteristics of additives and their specific use in foods. |
| **CO5** | Evaluate the dietary intake of individuals consuming foods with food additives. |
| **CO6** | Development of various instant premixes by addition of preservatives within the permissible limits. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23FP2018** | **Duration** | **3hrs** |
| **Course Title** | **UNIT OPERATIONS IN FOOD PROCESSING – II** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the application of vacuum in the evaporation process. | | CO2 | A | 1 |
| 2. | Identify the feeding mechanism, in which less number of pumps are used. | | CO5 | U | 1 |
| 3. | Define reflex ratio. | | CO4 | R | 1 |
| 4. | Define relative volatility. | | CO4 | R | 1 |
| 5. | Recall and write the critical temperature and critical pressure of CO2. | | CO1 | R | 1 |
| 6. | Give an example for liquid-solid extraction. | | CO3 | A | 1 |
| 7. | Give an example for absorption process. | | CO3 | U | 1 |
| 8. | Define adsorption equilibrium. | | CO2 | R | 1 |
| 9. | Illustrate the sequence of crystallization process. | | CO1 | U | 1 |
| 10. | Give an example for crystallization process. | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A multiple effect evaporator can process 500 kg of orange juice per hour from an initial solid content of 5% to final solid content of 25%. Calculate the amount of water evaporated. | | CO5 | An | 3 |
| 12. | Explain the boiling point concentration diagram with an example. | | CO4 | An | 3 |
| 13. | Write the advantages of CO2 in super critical fluid extraction process. | | CO1 | A | 3 |
| 14. | Write the six applications of the adsorption process. | | CO3 | A | 3 |
| 15. | Distinguish between homogeneous and heterogeneous nucleation. | | CO6 | An | 3 |
| 16. | Classify the extruder used in the food industry. | | CO2 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the short tube horizontal and vertical evaporators with a neat sketch. | CO3 | An | 8 |
|  | b. | Explain the feeding mechanisms used in multiple effect evaporators. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Derive an equation for relative volatility. | CO1 | An | 6 |
|  | b. | Explain the steam distillation process with a neat sketch. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the working principle of the Bollman extractor with a neat sketch. | CO3 | A | 6 |
|  | b. | Explain the working principle of super critical fluid extraction with a neat sketch. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain Langmuir’s adsorption isotherm with its assumptions and limitations. | CO4 | U | 8 |
|  | b. | Distinguish between physisorption and chemisorption. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe the draft tube baffle crystallizer with a neat diagram and list the applications of crystallizer in food processing. | CO6 | A | 8 |
|  | b. | Estimate the magnesium chloride crystallized out if the saturated concentration is only 54.5 kg/100 kg of water at 20⁰C. The solution contains 40 percent magnesium chloride solution in water at 20⁰C. | CO5 | E | 4 |
|  |  |  |  |  |  |
| 22. | a. | Apple juice with an initial solid concentration 10 per cent is being concentrated in a single effect evaporator to a final solid concentration of 40 per cent under a vacuum of 40 kPa. Steam at a pressure of 101 kPa is used to concentrate the juice. The feed enters at a temperature of 35oC and the temperature of the final juice is 86 oC corresponding to the vacuum of 40kPa prevailing in the evaporator. If the feed rate is 1000 kg/h, calculate the quantity of steam required and the heat transfer area of the evaporator. The specific heat of the feed is 5 kJ/kg oC, and the overall heat transfer coefficient is 1.9 kW/m2 oC. | CO5 | E | 9 |
|  | b. | Write the factors that affect the rate of evaporation. | CO6 | An | 3 |
|  |  |  |  |  |  |
| 23. | a. | A continuous rectification column with striping is used to distil a 1000 kg mixture of acetic acid and water which contains 40 per cent acetic acid (molar). The feed is a saturated vapor at its boiling point. The reflex ratio used is 2.6. It is desired to purify acetic acid up to 90 percent concentration (molar) in the bottom product and the top product containing 10 per cent acetic acid (molar). Determine the number of ideal plates and the location of the feed plate. The equilibrium data for acetic acid-water systems is given in the table.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **X** | 0 | 0.19 | 0.31 | 0.45 | 0.52 | 0.58 | 0.68 | 0.73 | 0.86 | 0.88 | 0.91 | 0.96 | 1 | | **Y** | 0 | 0.31 | 0.45 | 0.60 | 0.66 | 0.71 | 0.78 | 0.82 | 0.90 | 0.92 | 0.94 | 0.97 | 1 | | CO5 | E | 9 |
|  | b. | Analyze the material balance for distillation of two component systems. | CO2 | An | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the working principle of a single screw extruder with a neat sketch. | CO3 | A | 8 |
|  | b. | Write the factors affecting the rheological properties during extrusion cooking. | CO5 | An | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the properties of liquids and the unit operations related to them. |
| **CO2** | Understand the principles of various unit operations used in food industries. |
| **CO3** | Apply the knowledge of unit operations in mechanization of equipments for food industries. |
| **CO4** | Analyze the requirements for successful operation of evaporators, extractors, extrusion, crystallization and distillatory units. |
| **CO5** | Evaluate the efficiency of evaporators, extractors, extrusion, absorption, crystallization and distillatory units. |
| **CO6** | Design and analyze evaporators, extractors, extrusion, absorption, crystallization and distillatory units for the food industries. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2021** | **Duration** | **3hrs** |
| **Course Title** | **PROCESS ENGINEERING THERMODYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the law that deals with thermal equilibrium. | | CO1 | U | 1 |
| 2. | State the temperature at which the Joule Thomson Coefficient is zero. | | CO1 | R | 1 |
| 3. | Write the expression for the change in enthalpy for the steam generator. | | CO2 | R | 1 |
| 4. | State the function of a heat pump. | | CO2 | R | 1 |
| 5. | Write the unit for Gibbs free energy. | | CO3 | U | 1 |
| 6. | State the condition at which real gas will show ideal behavior. | | CO3 | U | 1 |
| 7. | Define Fugacity. | | CO4 | R | 1 |
| 8. | Indicate the driving force involved in chemical equilibria. | | CO4 | U | 1 |
| 9. | Identify the heat which cannot be measured by thermometer. | | CO5 | R | 1 |
| 10. | Interpret specific humidity. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between extensive and intensive properties. | | CO1 | An | 3 |
| 12. | Define coefficient of performance for the refrigerator. | | CO2 | U | 3 |
| 13. | Infer the limiting conditions for the equation of state. | | CO3 | An | 3 |
| 14. | Define chemical potential. | | CO4 | U | 3 |
| 15. | Compare dry with wet steam. | | CO5 | An | 3 |
| 16. | Define dew point depression. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Illustrate Joule Thompson porous plug experiment with a neat sketch and state the significance of µ. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Deduce an expression for the final velocity of air through a nozzle starting from steady flow energy equation. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Relate internal energy and Helmholtz free energy to obtain the two Maxwell’s thermodynamic relations based on these energies. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe vapor liquid equilibrium (VLE) with a neat sketch. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Report internal energy and entropy for wet and dry steam. | CO5 | A | 4 |
| b. | Explain in detail the formation of steam at constant pressure with a neat sketch. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 22. | a. | Interpret state and path function and give one example for each. | CO2 | A | 4 |
|  | b. | 5 kg of air at 40°C and 1 bar is heated in a reversible non-flow constant pressure until the volume is doubled. Find i) change in volume ii) Work done iii) Change in internal energy iv) Change in enthalpy. | CO2 | E | 8 |
|  |  |  |  |  |  |
| 23. |  | 50 kg/min of air enters the control volume in a steady flow system at 2 bar and 100°C and at an elevation of 100m above the datum. The same mass leaves the control volume at 150m elevation with the pressure of 10 bar and temperature of 300°C. The entrance velocity is 2400 m/min and the exit velocity is 1200 m/min. During the process, 50000 kJ/h of heat is transferred to the control volume and the rise in enthalpy is 8 kJ/kg. Calculate the power developed. | CO2 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Indicate the significance of various lines involved in the psychrometric chart with a neat sketch. | CO6 | U | 6 |
| b. | Dry bulb and wet bulb temperatures of 1 atmospheric air stream are 40°C and 30°C respectively. Determine i) Humidity ratio ii) Relative humidity iii) Specific enthalpy using Psychrometric chart. | CO6 | E | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Examine the properties of the thermodynamic system. |
| **CO2** | Explain various laws of thermodynamics related to food processing. |
| **CO3** | Calculate the properties of pure fluids. |
| **CO4** | Differentiate the properties of a component in a mixture. |
| **CO5** | Choose the properties of steam generated for food application. |
| **CO6** | Integrate the properties of air and water vapor systems for food processing. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2022** | **Duration** | **3hrs** |
| **Course Title** | **METABOLISM AND NUTRITION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Mention the enzyme involved in the last step of the EMP pathway. | | CO1 | R | 1 |
| 2. | Name the enzyme that catalyzes the conversion of glucose to glucose-6-phosphate. | | CO1 | R | 1 |
| 3. | Define health according to the W.H.O. | | CO2 | R | 1 |
| 4. | Define metabolism. | | CO2 | R | 1 |
| 5. | Define glycogenolysis. | | CO3 | R | 1 |
| 6. | Mention the chemical composition of proteins. | | CO3 | U | 1 |
| 7. | List examples of aromatic amino acids. | | CO4 | R | 1 |
| 8. | Describe low density lipoprotein (LDL). | | CO4 | U | 1 |
| 9. | Define anti-nutritional factors. | | CO5 | R | 1 |
| 10. | Define geriatric nutrition. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Calculate the Recommended Dietary Allowance (RDA) for a pregnant woman in her second trimester, BMR = 1400 kcal, Activity Factor (AF) = 1.6, and an additional 300 kcal for pregnancy. | | CO1 | A | 3 |
| 12. | List all factors affecting an individual food and nutrition. | | CO2 | R | 3 |
| 13. | Relate the different metabolic fates of pyruvate to their physiological conditions and significance. | | CO3 | U | 3 |
| 14. | Write about the significance of gluconeogenesis. | | CO2 | A | 3 |
| 15. | Describe cyanogen. | | CO5 | U | 3 |
| 16. | Write about macronutrient requirements at high altitude. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain in detail the processes of digestion and absorption of proteins in the human body. | CO2 | U | 5 |
|  | b. | Explain the clinical manifestations and nutritional management of Acute Kidney Disease (AKD) | CO1 | A | 5 |
|  | c. | Calculate the fluid requirement for a 56-year-old male with oliguric Acute Kidney Injury (AKI), given a urine output of 300 mL/day and insensible fluid loss of 500 mL/day. Explain the necessary nutritional modifications for potassium and sodium based on the provided lab values (Serum K⁺: 6.2 mEq/L, Serum Na⁺: 129 mEq/L, BUN: 72 mg/dL, Creatinine: 4.5 mg/dL) | CO1 | A | 2 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the glycolysis pathway comprehensively with a flowchart. | CO3 | R | 6 |
|  | b. | Explain the synthesis of fatty acids with a flowchart. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Write about genetic causes of carbohydrate metabolism errors and dietary management. | CO4 | An | 6 |
|  | b. | Describe the impact of dietary requirements and nutritional management on hepatitis and cirrhosis. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe the challenges and important considerations in geriatric nutrition. | CO6 | U | 6 |
|  | b. | Describe the metabolic pathways of the aliphatic amino acid glycine using a flow chart. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain specific nutritional recommendations during pregnancy and their impact on fetal development. | CO5 | U | 6 |
|  | b. | Explain micronutrient deficiencies and nutrition strategies preventing osteoporosis. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe malnutrition problems and effective preventive strategies implemented in our country. | CO1 | U | 6 |
|  | b. | Explain gluconeogenesis and metabolic pathway with a flow chart. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the role of the TCA cycle in carbohydrate metabolism with a flow diagram. | CO2 | A | 6 |
|  | b. | Explain the effects of phytates on mineral absorption and strategies for optimal nutrition. | CO3 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the role of nutrition in managing and preventing hypertension. | CO6 | R | 6 |
|  | b. | Explain the challenges and advancements in developing space foods. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Identify the structure of ATP and the major class of macromolecules to which ATP belongs. |
| **CO2** | Describe the biochemistry process, basic concept of human nutrition and the relationship of the consumption of foods to nutritional status and health. |
| **CO3** | Apply their knowledge in food biochemistry and nutrition in designing new range of products with improved nutritional characteristics (Nutraceuticals and functional foods). |
| **CO4** | Analyze the stages in catabolism of food molecules and describe what occurs during each stage. |
| **CO5** | Evaluate the biological functions of foods for health in addition to nutritional values. |
| **CO6** | Formulate specialized nutrition for pediatric, geriatric and sport’s needs. |



END SEMESTER EXAMINATION – NOV / DEC 2025

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| **Course Code** | **23FP2025** | **Duration** | **3hrs** |
| **Course Title** | **FOOD PACKAGING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q.**  **No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Recall why packaging is often referred as the “**silent salesman**”. | | CO1 | R | 1 |
| 2. | List any two packaging trends in the modern packaging era. | | CO1 | U | 1 |
| 3. | State the two types of heat seals that are possible on plastic packages. | | CO2 | R | 1 |
| 4. | Indicate the main advantage of dielectric sealing over traditional heat sealing. | | CO2 | U | 1 |
| 5. | Recognize the examples of aerosol cans used in the food industry. | | CO3 | R | 1 |
| 6. | State the purpose of surface treatment in glass containers. | | CO3 | R | 1 |
| 7. | Explain the significance of orientation process in plastic films. | | CO4 | U | 1 |
| 8. | Differentiate b thermoplastics from thermoset plastics | | CO4 | U | 1 |
| 9. | List any two physical tests conducted on packaging materials. | | CO5 | R | 1 |
| 10. | Express the purpose of biodegradable packaging | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Appraose the 4 main functions of packaging with examples. | | CO1 | An | 3 |
| 12. | Interpret the main parameters influencing seal quality in plastic film sealing. | | CO2 | An | 3 |
| 13. | Indicate the types and purpose of surface treatments in glass container production. | | CO3 | U | 3 |
| 14. | Explain the principle and advantages of coextrusion. | | CO4 | An | 3 |
| 15. | Categorise the types of vacuum packaging systems used in the food industry. | | CO5 | An | 3 |
| 16. | Illustrate the structure of a retort pouch. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze the reason for food spoilage and the need for packaging. | CO1 | An | 6 |
|  | b. | Illustrate the timeline of evolution of packaging. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Interpret the working principle of the following types of sealing techniques used in the food industry namely impulse, ultrasonic and induction sealing. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Illustrate the manufacturing processes of both three-piece and two-piece cans using suitable diagrams and highlight their differences. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Describe the surface treatments used in plastic film manufacturing. | CO4 | U | 8 |
|  | b. | Compare the injection molding process with compression molding process for making rigid plastic containers. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. |  | Outline the paper manufacturing process from pulping to finishing. | CO5 | An | 12 |

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| 22. | a. | Describe the operation of a vertical form-fill-seal (VFFS) machine. | CO2 | U | 8 |
|  | b. | Explain the working principle of aseptic packaging. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the various tests used in the evaluation of packaging material. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the different equipments used in modified atmosphere packaging of foods. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the need for appropriate packaging |
| **CO2** | Compare the various types of sealers and fillers used in food packaging systems. |
| **CO3** | Gain insight on the advanced packaging methodologies used in the food industry. |
| **CO4** | Evaluate the suitability of a food package based on physical, chemical, and mechanical properties. |
| **CO5** | Articulate the methods of testing of packaging materials. |
| **CO6** | Devise novel eco-friendly packages for food systems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2040** | **Duration** | **3hrs** |
| **Course Title** | **PRODUCT PACKAGING AND LABEL DESIGN** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name two key standard certifications of biodegradable packaging materials. | | CO6 | R | 1 |
| 2. | Classify two common aseptic package formats. | | CO6 | U | 1 |
| 3. | Extend VOC. | | CO5 | U | 1 |
| 4. | Name two key standard certifications of biodegradable packaging materials. | | CO6 | R | 1 |
| 5. | Name two packaging requirements for fats and oils. | | CO4 | R | 1 |
| 6. | State triangle test. | | CO3 | R | 1 |
| 7. | Name two early packaging innovated during ancient time. | | CO1 | R | 1 |
| 8. | Define secondary packaging. | | CO2 | R | 1 |
| 9. | Identify any two labeling considerations for glass packaging. | | CO2 | U | 1 |
| 10. | Name any two sustainability factors affecting quality of packaging material. | | CO1 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the importance of packaging. | | CO1 | U | 3 |
| 12. | Illustrate the advantages of plastics. | | CO2 | An | 3 |
| 13. | Describe accelerated shelf life testing. | | CO3 | R | 3 |
| 14. | Distinguish between retorting and hot filling in packaging of thermally processed foods and beverages. | | CO4 | U | 3 |
| 15. | Examine the mandatory components of a nutrition facts panel. | | CO5 | U | 3 |
| 16. | Explain the principles of biodegradable packaging materials. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the types and levels of Packaging. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Summarize the manufacturing process of tin and aluminum cans. | CO2 | U | 12 |
| 19. | a. | Explain the procedures used for testing the packaging materials. | CO3 | A | 6 |
|  | b. | Examine the thickness, tensile strength, and puncture resistance and its measurements in detail. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe modified atmospheric packaging of fresh horticulture produce. | CO4 | An | 6 |
|  | b. | Explain the primary packaging technologies of meat. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Discuss in detail on the informations in mandatory declaration panel. | CO5 | U | 6 |
|  | b. | Describe nutritional labeling on packages. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Discuss in detail on global trends in eco-friendly and smart packaging. | CO1 | U | 6 |
|  | b. | Identify various copolymers and food packaging applications. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Examine the testing types for packaged foods on compatibility and shelf life studies. | CO3 | U | 6 |
|  | b. | Illustrate the structure of standard flexible packaging for snacks and coffee. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe the primary types of active and smart packaging systems. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Recall the terminologies used in food packaging. |
| **CO2** | Understand the need for product packaging. |
| **CO3** | Examine the shelf life of food. |
| **CO4** | Analyze the different packaging materials based on their properties and their application. |
| **CO5** | Evaluate and select different printing and labeling methods based on legislative requirements. |
| **CO6** | Devise ecofriendly and edible food packaging materials. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **23FP2049** | **Duration** | **3hrs** |
| **Course Title** | **PROCESSING OF FOOD COMMODITIES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **CO** | | **BL** | | **M** | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | | |
| 1. | Enlist two chemical properties used as quality parameters for wheat quality. | | | CO1 | | R | | 1 | |
| 2. | Mention the particle size of Maida. | | | CO1 | | U | | 1 | |
| 3. | List two examples for humectants. | | | CO2 | | A | | 1 | |
| 4. | Cite the optimal fermentation temperature for sponge fermentation. | | | CO2 | | U | | 1 | |
| 5. | Recall the TSS of Jam. | | | CO3 | | R | | 1 | |
| 6. | Define standard milk. | | | CO4 | | R | | 1 | |
| 7. | State the caffeine content of freshly ground coffee. | | | CO5 | | R | | 1 | |
| 8. | Cite the inlet and exhaust temperature for fluidised bed drier. | | | CO5 | | U | | 1 | |
| 9. | Define Encapsulation | | | CO6 | | R | | 1 | |
| 10. | Indicate the fat and carbohydrate composition of cocoa bean | | | CO6 | | U | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | | |
| 11. | List five examples of beneficial microorganisms present in milk. | | | CO3 | | R | | 3 | |
| 12. | List the types of pasteurization methods. | | | CO4 | | U | | 3 | |
| 13. | Describe any three tests for the quality of black tea. | | | CO5 | | R | | 3 | |
| 14. | Write any six minimum quality standards for black tea. | | | CO5 | | U | | 3 | |
| 15. | Summarize the functional properties of ginger. | | | CO6 | | U | | 3 | |
| 16. | Write the stages of fermentation in primary processing. | | | CO6 | | A | | 3 | |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | | | | | |
| 17. |  | Illustrate the various steps involved in the manufacture of bread by straight dough fermentation process. | CO1 | | An | | 12 | |
|  |  |  |  | |  | |  | |
| 18. |  | Write in detail on the canning process for fruits and vegetable with a flowchart. | CO2 | | A | | 12 | |
|  |  |  |  | |  | |  | |
| 19. | a. | Describe in detail the grades and types of wheat flour. | CO1 | | R | | 6 | |
|  | b. | Describe the manufacturing process of jellies with a flowchart. | CO2 | | U | | 6 | |
|  |  |  |  | |  | |  | |
| 20. | a. | Explain the process for the manufacture of Pasteurized milk. | CO3 | | An | | 6 | |
|  | b. | Explain in detail about any two equipment used for milk processing. | CO3 | | U | | 6 | |
|  |  |  |  | |  | |  | |
| 21. | a. | Write the manufacturing process of sausage with a flow chart. | CO4 | | A | | 6 | |
|  | b. | Discuss in detail about carcass processing of buffalo. | CO4 | | U | | 6 | |
|  |  |  |  | |  | |  | |
| 22. | a. | Survey the common platform tests performed during reception of milk. | CO3 | | A | | 6 | |
|  | b. | Discuss in detail the primary processing of cocoa beans with a flowchart. | CO6 | | U | | 6 | |
|  |  |  |  | |  | |  | |
| 23. |  | Explain the manufacturing process of black tea. | CO5 | | U | | 12 | |
| **COMPULSORY QUESTION** | | | | | | | | | |
| 24. | a. | Illustrate the methods of processing of Pepper with a flowchart. | CO6 | | An | | 6 | |
|  | b. | Discuss in detail the manufacturing process of chocolate with a flowchart. | CO6 | | U | | 6 | |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recognize the physicochemical characteristics of various food commodities. |
| **CO2** | Understand the processing technologies involved in food processing industries. |
| **CO3** | Apply their knowledge in the manufacture of novel food products. |
| **CO4** | Categorize the methods of preservation in food production. |
| **CO5** | Choose the best fit processing technique for a specific food commodity. |
| **CO6** | Distinguish the various layouts of food processing based on the ease of operation. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **24FP3002** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED PROCESS DESIGN OF EQUIPMENT** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the basic considerations involved in designing process equipment for food and chemical industries. | CO1 | U | 10 |
|  | b. | Illustrate the steps involved in preparing a process flow diagram (PFD) for a simple heat exchanger system. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Articulate the basic design principles that must be considered while designing pressure vessels used in food processing. | CO2 | A | 10 |
|  | b. | Categorise the difference between thin-walled and thick-walled pressure vessels with suitable examples. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the factors affecting the estimation of cooling load in cold storage design. | CO3 | U | 10 |
|  | b. | Differentiate between **refrigerated storage, controlled atmosphere (CA)** storage, and **modified atmosphere (MA)** storage. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare the design considerations of controlled atmospheric storage and modified atmospheric storage for perishables. | CO3 | U | 10 |
|  | b. | Prepare a **cold storage layout** showing major zones — pre-cooling chamber, loading/unloading dock, cold chamber, compressor room, and air handling units. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Differentiate between batch, continuous stirred tank, and plug flow reactors in terms of operation and application | CO4 | U | 10 |
|  | b. | Analyse the effect of reactor geometry on mixing efficiency and reaction rate in a continuous stirred tank reactor | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the classification of heat exchangers based on flow arrangement and construction. | CO5 | U | 10 |
|  | b. | Explain the main steps involved in the design of shell and tube exchanger. | CO5 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Describe the working principle of a tray dryer and its suitability for different food materials. | CO6 | U | 10 |
|  | b. | A tray dryer dries 50 kg of wet fruit slices from 80% to 10% (wet basis) moisture in 6 hours. Calculate the **rate of moisture removal (kg/h)(Assume necessary data)** | CO6 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Design a **mixing tank** to hold 0.5 m³ of viscous liquid. Suggest appropriate agitator type, baffle arrangement, and motor power rating (assume typical design parameters). | CO6 | A | 10 |
|  | b. | Describe the function and design considerations of baffles in an agitated mixing vessel | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Compare the performance of **tray dryer, fluidized bed dryer** and **solar dryer** in terms of drying rate, product quality, and energy efficiency. | CO6 | U | 10 |
|  | b. | Define the term critical moisture contentand explain its importance in dryer design. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the factors that affect the design of equipment. |
| CO2 | Classify the design variables based on various properties. |
| CO3 | Relate various process variables. |
| CO4 | Prioritize the critical variables for the design of equipment. |
| CO5 | Recommend a conceptual design model. |
| CO6 | Assess the validity of the conceptual model. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **24FP3002** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED PROCESS DESIGN OF EQUIPMENT** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Explain the importance of mechanical properties of materials used in process equipment design. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Illustrate the importance of static and dynamic stress in the design of food processing equipment. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | A cold storage room is to be constructed with an inner layer of 5 mm wood board, a middle layer of cork board and an outer layer of 10 mm of brick. Air inside the cold storage is to be maintained at 5°C. The maximum air temperature outside the cold storage is expected to reach 50°C. Thermal conductivities of wood, cork board and brick are 0.15, 0.043 and 0.69 W/m K respectively. The convective heat transfer coefficient of inside and outside air are 100 and 10 W/m2 K respectively. What thickness of cork board is needed to keep the heat loss to 10 W/m2. | CO3 | An | 8 |
| b. | Explain Controlled Atmospheric Storage (CAS) and state its application and limitations. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | It is proposed to operate a batch reactor for converting A into R. This is a liquid phase reaction with the stoichiometry A gives R. Find the time required to drop the concentration of A from CAo = 1.3 mol/l to CAf =0.30 mol/l? The rate v/s concentration data are as given below:   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | CA, (mol/l) | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.3 | 2.0 | | -rA, (mol/l.min) | 0.1 | 0.3 | 0.5 | 0.6 | 0.5 | 0.25 | 0.10 | 0.06 | 0.05 | 0.045 | 0.042 | | CO4 | E | 10 |
| b. | Deduce the design equation for the Continuous Stirred Tank Reactor (CSTR) starting from the steady state material balance equation. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 5. | a. | Compare the Log Mean Temperature Difference (LMTD) for parallel flow and counter flow. | CO5 | An | 6 |
| b. | Explain the construction and operation of 1,1 Shell and tube heat exchanger. | CO5 | U | 10 |
|  |  |  |  |  |  |
| 6. | a. | Develop the expression for overall heat transfer coefficient for the combined mode of heat transfer. | CO4 | A | 8 |
| b. | Calculate the heat transfer coefficient for fluid flowing through a tube having inside diameter 40 mm at a rate of 5500 kg/hr. Assume that the fluid is being heated. Properties of the fluid at mean bulk temperature are i. viscosity of flowing fluid 0.004 N.s/m2, density of flowing fluid 1.07 g/cm3, specific heat of flowing fluid 2.72 kJ/kgK, thermal conductivity of flowing fluid 0.256 W/m K. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the energy and material balance for the double effect evaporator. | CO5 | U | 6 |
| b. | A single-effect evaporator is to be designed to concentrate 10000 kg/hr of a chemical solution from 10% to 20% solids by weight. Feed enters at 30°C. Saturated steam at 110°C (latent heat of 540 kcal/kg) is available. Condensate leaves at saturation temperature. The solution boils at 45°C (latent heat = 570 kcal/kg). Specific heats of all solutions may be taken as 1.0. U may be taken as 1800 kcal/hrm2 °C. Calculate i. Steam consumption, kg/hr and ii. Heat transfer area. | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | 1000 kg (dry mass) of non-porous solid is dried under constant drying conditions with an air velocity of 0.75 m/s. The area of the drying surface is 55 m2. If the initial rate of drying is 0.3 g/m2s, how long will it take to dry a material from 0.15 to 0.025 kg water/kg dry solid? The critical moisture content is 0.125 kg water/kg dry solid. Assume that the falling rate is linear. The equilibrium moisture content may be assumed to be zero. If the air velocity is increased to 4 m/s, what will be the anticipated saving in drying time? Assume that the rate of evaporation in a constant rate period is proportional to the air velocity raised to the power of 0.8. | CO6 | A | 10 |
| b. | Describe batch drying operations with suitable curves. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify the factors that affect the design of equipment. |
| CO2 | Classify the design variables based on various properties. |
| CO3 | Relate various process variables. |
| CO4 | Prioritize the critical variables for the design of equipment. |
| CO5 | Recommend a conceptual design model. |
| CO6 | Assess the validity of the conceptual model. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **24FP3007** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED DRYING TECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the **phenomenon of hysteresis** observed in sorption isotherms and discuss its causes. | CO1 | A | 10 |
|  | b. | Draw and explain a typical **drying rate curve** and describe the constant and falling rate periods. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the **working principle** of a **pulsed fluid bed dryer** and its application in the food industry. | CO2 | U | 10 |
|  | b. | Discuss the **impact of nozzle design** (angle, diameter, spacing) on heat and mass transfer in impingement dryers. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | 500 kg of paddy at 22% moisture content (wb) is dried to 14% moisture content (wb) for milling. Calculate the amount of moisture removed in drying. | CO1 | A | 10 |
|  | b. | Analyse how **food composition (carbohydrate, protein, fat content)** influences drying behavior and final product texture. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the **advantages** of using superheated steam instead of air for drying heat-sensitive food products. | CO3 | A | 10 |
|  | b. | Describe the **mathematical modeling approaches** commonly used to predict drying kinetics in low-pressure steam drying. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the **mechanism of heat and mass transfer** in a heat pump dryer. | CO4 | A | 10 |
|  | b. | Compare **single-stage, multi-stage compression**, and **cascade heat pump dryers** in terms of performance and energy utilization. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe **refractance window drying** and its principle with a neat diagram. | CO5 | U | 10 |
|  | b. | Describe vacuum jet drying and its principle with a neat diagram. | CO5 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the **advantages and limitations** of pulse combustion drying for food products. | CO6 | A | 10 |
|  | b. | Explain the **basic concept of hybrid drying systems** combining pulse combustion with microwave or convective drying. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Examine how **cascade heat pump drying systems** improve energy utilization compared to conventional dryers. | CO6 | A | 10 |
|  | b. | Explain the concept of **airless drying** and how it minimizes oxidation in food products. | CO6 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the classification of solar dryers with a neat sketch. | CO1 | U | 10 |
|  | b. | Explain the **working principle** of a **phase change material (PCM)** used in solar dryers. | CO1 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Learn the selection of suitable drying technology for a specific food. |
| CO2 | Demonstrate the advanced drying technology for good quality food products. |
| CO3 | Analyze the efficiency of industrial dryers. |
| CO4 | Evaluate the dryer performance. |
| CO5 | Design and propose the concept of hybrid drying to solve a specific drying problem in the food industry. |
| CO6 | Model and simulate a simple drying process for food. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25FP201** | **Duration** | **3hrs** |
| **Course Title** | **CALCULUS AND LINEAR ALGEBRA FOR FOOD PROCESSING** | **Max. Marks** | **100** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Scale up the base recipe by a factor of 8 to produce a larger volume of the beverage using the given 3 × 3 ingredient matrix for the beverage formulation. | 1a | R | 1 |
| 2. | Identify the trace of the matrix that models temperature – pressure correlations in a sterilization process. | 1a | R | 1 |
| 3. | Identify the matrix of the quadratic form representing the mixing uniformity index in a grain blending process, given by  Where x, y and z denote the temperature (oC) in the three pasteurization stages. | 2e | U | 2 |
| 4. | *List* the eigenvalues of the matrix representing the mass flow interaction matrix for three stages of juice concentration in an evaporator system. | 2b | U | 2 |
| 5. | Identify whether the function is linear or not linear. | 3a | R | 3 |
| 6. | Identifythe rate of change of dough expansion with  with respect to proofing time x in a bread baking process. | 3b | R | 3 |
| 7. | Illustrate how to use a single integral to calculate the total heat absorbed by a food product during convection drying, given the temperature function over time. | 4a | U | 4 |
| 8. | Illustratehow to compute the total heat absorbed in a rectangular baking chamber using double integral where represents the temperature distribution (oC) along the length (x) and the width (y) of the chamber in a baking process. | 4c | U | 4 |
| 9. | Identify whether the dough sheet thickness function is an even function. | 5a | R | 5 |
| 10. | State the Dirichlet conditions for Fourier Series expansion use in modeling the temperature function in a continuous food pasteurization system. | 5b | R | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | In a food drying process, the energy contribution of three sources are modeled by the matrix. Determine using row transformations. | 1c | A | 1 |
| 12. | Compute the nature of the quadratic form  that represents the variability in nutrient content, pH and dissolved oxygen during the fermentation of probiotic beverage using its eigenvalues. | 2e | An | 2 |
| 13. | Evaluate the Jacobian for the milk processing system given by  , , where x, y and z represent the heating time (minutes), stirring speed (rpm) and fat content (%) at the point (1, – 1, 0) | 3d | A | 3 |
| 14. | Compute the total heat energy in a 3D food drying chamber. | 4e | A | 4 |
| 15. | Determine the RMS value of the pressure function over the interval [0,2], representing decaying pressure inside a food extrusion barrel. | 5d | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Determine the amounts (in kgs) of three ingredients wheat flour (x), sugar (y) and oil (z) using Cramer’s rule required for three product mixes given by *x + 0y + 2z = 4* ; 0*x + y + z = 4* ; 2*x + y + z = 8* . | 1d | A | 1 |
| **(OR)** | | | | |
| 17 | Find the required quantities (in litres) of milk (x), fruit syrup (y) and water (z) needed to prepare three types of flavored beverages based on the following blending requirements *x + y + z = 6, 2x + 3y + z = 11, x + 2y + 3z = 14* using Gauss Jordan Method | 1e | A | 1 |
| 18 | Determine the initial temperature settings ( ) that yields uniform cooling across all the zones for the matrix representing temperature response matrix of a three-zone refrigerated storage system used for dairy products using the Cayley – Hamilton theorem. | 2c | A | 2 |
| **(OR)** | | | | |
| 19 | Compute the canonical form of the quadratic expression  representing the vibration energy of a triple-shaft centrifugal clarifier used in dairy processing, where x, y and z denote the displacement amplitude of the three shafts. | 2e | A | 2 |
| 20 | Determine all the first order partial derivatives and second order partial derivatives of the viscosity function with respect to stirring speed (x) and temperature (y) in a sauce preparation process, where *f* represents the viscosity of the sauce. | 3c | A | 3 |
| **(OR)** | | | | |
| 21 | Find the drying temperature (x) and drying time (y) that minimize moisture loss in a food product, subject to the constraint  using Lagrange Multiplier method. | 3e | An | 3 |
| 22 | Determine the cross-sectional area of a circular pipe given by  used to transport milk in a dairy processing plant. | 4d | A | 4 |
| **(OR)** | | | | |
| 23 | Calculate the volume of the tetrahedron given by the equation ,  y , z and formed by the proportions of four key ingredients (flour, sugar, cocoa and milk powder) in a chocolate formulation. | 4e | A | 4 |
| **Compulsory Question:** | | | | |
| 24 | The heat intensity along the circumference of a circular oven has the following data.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | *x* | 00 | 600 | 1200 | 1800 | 2400 | 3000 | | *y* | 0.8 | 0.6 | 0.4 | 0.7 | 0.9 | 1.1 |   Determine the first three harmonics for the Fourier Series Expansion. | 5e | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP202** | **Duration** | **3hrs** |
| **Course Title** | **Applied Physics for Food Process Operations** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Define the characteristics of musical sound waves. | 1a | R | 1 |
| 2. | Classify the sound waves based on their frequencies. | 1b | U | 1 |
| 3. | Identify two important properties of ultrasonic waves. | 2a | R | 2 |
| 4. | Compare ‘audible sound waves’ with ‘ultrasound waves’. | 2b | U | 2 |
| 5. | List the types of electromagnetic waves. | 3a | R | 3 |
| 6. | Describe ionizing radiation. | 3b | U | 3 |
| 7. | Name the parts of a laser system. | 4a | R | 4 |
| 8. | Differentiate ‘spontaneous emissions’ from ‘stimulated emissions’. | 4b | U | 4 |
| 9. | State the basic definition of numerical aperture. | 5a | R | 5 |
| 10. | Discuss two important applications of single mode optical fiber cables. | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Compute acoustical efficiency of a food-processing factory using Sabine’s formula of reverberation time. Calculate the reverberation time of a factory whose volume is (100 m \* 40 m \* 20 m) and the total absorption coefficient is 7333.33 O.W.U. or sabines. Infer whether this reverberation time is good for speech communication. | 1c | A | 1 |
| 12. | Express whether the following iron rod can be used for producing ultrasonic waves. The iron rod is having a length of 40 mm. The density of pure iron is 7.25 x 103 kg/m3 and its Young’s modulus is 115 x 109 N/m2. | 2c | U | 2 |
| 13. | Calculate the electric field produced by a 103 W laser beam focused by a lens of cross section area 10-6 cm2.  [Given that ε0 = 8.854 x 10-12 C2N-1m-2.; c = 3 x 108 m/s] | 3c | A | 3 |
| 14. | Infer the wavelength of the light emitted from a laser system used in food processing industry at 360 K. The ratio of population of two energy levels in this industrial laser is 1.059 x 10-30.  [Given that c = 3 x 108 m/s; k = 1.38 x 10-23 J/K; h = 6.626 x 10-34 J. s] | 4c | U | 4 |
| 15. | Compute the numerical aperture and acceptance angle of an optical fiber sensor if the refractive indices for core and cladding are 1.59 and 1.49 respectively. | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Determine the reverberation time of a food-processing hall having a volume of 1500 m3. Its total absorption is equivalent to 100 m2 of open window unit or sabines. In order to bring its reverberation time to half its initial value, compute the change in its total absorption. | 1d | A | 1 |
| **(OR)** | | | | |
| 17 | Explain the factors that affect the acoustic quality of a food processing factory room and suggest remedies for the same. | 1e | An | 1 |
|  | | | | |
| 18 | Explain the methods to find the first three excited frequencies for the following system. A piezoelectric crystal is used in the production of ultrasonic waves that are used for processing food items in a certain food industry. It is having a thickness of 1 mm that is vibrating at resonance. It is having a Young’s Modulus value Y = 7.9 x 1010 N/m2 and density ρ = 2650 kg m-3. | 2d | A | 2 |
| **(OR)** | | | | |
| 19 | Criticize the applications of ultrasonic waves in diary and beverages industry through the process of cavitation. | 2e | An | 2 |
|  | | | | |
| 20 | Predict the intensity of a 100 W incandescent bulb at a distance of 10 m from a given surface. Calculate its electric field and infer the suitability of this electromagnetic source in food processing industry.  [Given that ε0 = 8.854 x 10-12 C2N-1m-2.; c = 3 x 108 m/s] | 3d | A | 3 |
| **(OR)** | | | | |
| 21 | Deduce how Eddy Current testing is used in the food processing industry for quality control, inspection, and safety assurance. | 3e | An | 3 |
|  | | | | |
| 22 | Solve the given situation in a food processing industry. The first line of the principal series of sodium is the D line at 590 nm. Compute the fraction of sodium atom in its first excited state in a sodium vapour lamp at a temperature of 250 ⁰C. Explain why this light source is not preferred over laser light source.  [Given that c = 3 x 108 m/s; k = 1.38 x 10-23 J/K; h = 6.626 x 10-34 J. s] | 4d | A | 4 |
| **(OR)** | | | | |
| 23 | Distinguish between a gaseous laser and a semi-conductor laser with suitable examples. Explain how a gaseous laser is advantageous over a semiconductor laser in a food processing industry. | 4e | An | 4 |
| **Compulsory Question:** | | | | |
| 24 | Evaluate an optical fiber sensor cable with the following parameters. A step index fiber has a numerical aperture of 0.26, a core refractive index of 1.5 and a core diameter of 100 μm. Calculate the refractive index of the cladding, angle of acceptance and the maximum number of modes with a wavelength of 1 μm that the fiber can carry. | 5d | E | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **25FP207** | **Duration** | **3hrs** |
| **Course Title** | **C PROGRAMMING FOR FOOD PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Define a variable in C with an example related to food temperature monitoring. | 1a | R | 1 |
| 2. | List any two arithmetic operators and explain their use in food quantity calculations. | 1b | R | 1 |
| 3. | List the steps involved in Bubble Sort for arranging fruit sizes. | 2a | U | 2 |
| 4. | Describe Linear Search with respect to finding a batch ID in food inventory. | 2b | U | 2 |
| 5. | Label the parts of a function prototype with a food quality testing example. | 3a | R | 3 |
| 6. | State two advantages of using functions in recipe value calculation. | 3b | R | 3 |
| 7. | Define a pointer and explain its use in accessing ingredient quantities. | 4a | U | 4 |
| 8. | Describe the significance of loops in food mixing automation. | 4b | U | 4 |
| 9. | Identify the components needed to design a food inventory interface. | 5a | A | 5 |
| 10. | List uses of structures in managing raw material data in food processing. | 5b | A | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Write a C program to find the largest of three nutrient values using if-else. | 1b | A | 1 |
| 12. | Analyze grain weights stored in an array and sort them using Bubble Sort. | 2a | An | 2 |
| 13. | Develop a modular program to compute total calories of a food recipe using functions. | 3a | A | 3 |
| 14. | Evaluate the use of pointers to update stock levels in a food warehouse. | 4c | An | 4 |
| 15. | Write a C program using structures and switch-case to manage juice production batches. | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Develop a C program to simulate a Milk Pasteurization Temperature Monitoring System. | 1d | A | 1 |
| **(OR)** | | | | |
| 17 | Design a modular C program to evaluate Food Batch Quality based on microbial count, pH, and moisture. | 1d | An | 1 |
|  | | | | |
| 18 | Construct a C program to manage employee records in a food factory using arrays and search. | 2d | A | 2 |
| **(OR)** | | | | |
| 19 | Develop a program to perform matrix operations for nutrient comparison of food samples. | 2d | An | 2 |
|  | | | | |
| 20 | Construct a C program using pointer arithmetic to compute min and max flour particle size. | 3d | A | 3 |
| **(OR)** | | | | |
| 21 | Develop a dynamic memory allocation-based Raw Material Database System. | 3d | A | 3 |
|  | | | | |
| 22 | Design a file-handling program to manage daily production logs in a food processing plant. | 4d | A | 4 |
| **(OR)** | | | | |
| 23 | Create a C program using structures and file handling to analyze packaged food label data. | 4d | A | 4 |
|  | | | | |
| **Compulsory Question:** | | | | |
| 24 | Design a simple 2D mini gaming application in C using graphics or ASCII characters. The program should simulate object movement (like a bouncing ball or a moving character) and handle user input for direction control. Ensure modularity using functions and proper use of loops and conditions. | 5d | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25FP210** | **Duration** | **3hrs** |
| **Course Title** | **BAKERY, BEVERAGES & CONFECTIONERY TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | The Hagberg Falling number of a given flour is 150.Predict the applicability of the flour for bread manufacture. | 1b | U | 1 |
| 2. | Choose a relevant mixer that can be used for cake batter mixing. | 1d | R | 1 |
| 3. | Listthe temperature and relative humidity combination to be maintained during the proofing process of bread manufacture. | 2b | U | 2 |
| 4. | List any 2 possible reasons for a sunken cake. | 2d | U | 2 |
| 5. | List any 2 methods of sugar cane evaluation. | 3a | R | 3 |
| 6. | Describe the composition of massecuite in 100 words. | 3b | R | 3 |
| 7. | A grape pulp sample has a soluble solid content of 16%. Calculate the amount of sugar required to make the soluble solid content to 28%. | 4a | A | 4 |
| 8. | Suggest any two low-calorie natural sweeteners that can be added for a low-calorie carbonated beverage. | 4e | A | 4 |
| 9. | Describe the process of ***doctoring*** of hard boiled candies in 100 words. | 5a | U | 5 |
| 10. | Suggest any 2 gelling agents that can be used for jelly preparation. | 5e | R | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Describe the principle and working of an alveograph in 400 words. | 1b | U | 1 |
| 12. | Justify the choice of co-extrusion as a method for the manufacture of center-filled biscuits in 400 words, suggesting a relevant formulation for the same. | 2c | A | 2 |
| 13. | The cane sugar manufacturing industry desires to increase the yield of pressed juice from the procured sugarcane. Develop a relevant technology for the same, incorporating the principles involved in 400 words. | 3b | A | 3 |
| 14. | M/s. LL plans to develop a technology for the manufacture of whiskey using wheat grains. Sketch relevant technology for the same in 400 words. | 4a | C | 4 |
| 15. | Develop sketches, a technology for the manufacture of vegan toffees in 400 words | 5c | C | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Explain with a sketch, the process of milling wheat to *rawa* in 500 words. | 1a | A | 1 |
| **(OR)** | | | | |
| 17 | Justify the choice of a. alveograph and b. extensograph values of a wheat dough for its application in the multigrain bread. (300 words each) | 1e | A | 1 |
|  |  |  |  |  |
| 18 | Describe with sketch the process for the manufacture of high-fibre biscuits with suitable ingredients in 500 words | 2c | C | 2 |
| **(OR)** | | | | |
| 19 | Describe with sketch the process for the manufacture of vegan cakes, with suitable ingredients in 500 words | 2b | C | 2 |
| 20 | Describe the process of sulphitation of cane sugar juice in 500 words. | 3b | U | 3 |
| **(OR)** | | | | |
| 21 | Justify the currently followed processes for the manufacture of a. Jaggery and b. *Khandsakhar*.(300 words each) | 3e | An | 3 |
|  |  |  |  |  |
| 22 | XX wants to develop technology for the manufacture of banana wine. Develop relevant technologies for the same, if the ⸰brix of the pulp is 18 in 500 words. | 4c | C | 4 |
| **(OR)** | | | | |
| 23 | XX wants to develop low-calorie carbonated beverages using natural sweeteners. Describe the process for the manufacture of the same with suitable additives. | 4e | C | 4 |
| **Compulsory Question:** | | | | |
| 24 | Describe with sketch the process for the manufacture of dark chocolates | 5d | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25FP702** | **Duration** | **3hrs** |
| **Course Title** | **FOOD STRUCTURING TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the role of hydrocolloids and proteins in the development and stabilization of food structure with suitable examples. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Examine the factors affecting the formation, destruction, and destabilization of food matrices during processing and storage. | CO1 | A | 20 |
|  |  |  |  |  |  |
| 3. |  | Compare the wet spinning, electrospinning, and extrusion techniques used in structuring plant-based or cultured proteins. | CO2 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Distinguish between 3D and 4D food printing technologies, focusing on materials science principles, print mechanisms, and end-product functionality. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain the principles and preparation methods of food emulsions with suitable examples. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Interpret the mechanism of foam and bubble formation and identify the factors influencing their stability in food products. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Compare microencapsulation and nano encapsulation techniques used in food processing. | CO4 | An | 10 |
|  | b. | Analyze the criteria for selecting wall and core materials in the encapsulation of bioactive food compounds. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate the role of edible moisture barriers in food stabilization, highlighting materials used, mechanisms of moisture control, and practical applications. | CO4 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Evaluate the principles behind designing encapsulation systems for bioactive delivery, emphasizing the structural and mechanical stability of the food matrix. | CO5 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Evaluate the techniques involved in the design of engineered food systems. |
| CO2 | Evaluate the choice of materials used for fibrous structure formation and food printing. |
| CO3 | Choose the relevant emulsion systems for structuring functional foods. |
| CO4 | Choose the suitable encapsulation methods for structuring polyphasic food systems. |
| CO5 | Develop the relevant structured food systems for various applications. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP703** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCES IN INDUSTRIAL MICROBIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | **Design** a systematic protocol for the primary and secondary screening of a soil sample to isolate a bacterium that produces an extracellular amylase enzyme. | CO1 | C | 10 |
|  | b. | **Compare** the principles and industrial applications of any two modern techniques used for the long-term preservation of microbial cultures. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | **Formulate**the composition of a defined minimal medium for cultivating an industrial microorganism. | CO2 | C | 10 |
|  | b. | **Analyze**the physiological state of bacteria during the death phase of a batch culture . | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | * **Construct** a dichotomous key for the identification of an unknown Gram-negative bacterium using a logical sequence of three standard biochemical tests. | CO3 | C | 10 |
|  | b. | **Differentiate** between the mechanisms of Gram staining and Acid-fast staining, explaining how the cell wall structure dictates the staining outcome in each case. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | **Develop** a sterilization protocol for a batch of heat-labile vitamin solution, justifying the chosen method and the critical parameters that must be controlled to ensure sterility without degrading the product. | CO4 | C | 10 |
|  | b. | **Evaluate** the efficacy of moist heat sterilization versus ethylene oxide gas for sterilizing surgical kits, considering their mode of action, penetration ability, and material compatibility | CO4 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | **Critique**the statement: "The 12D concept provides an absolute safety guarantee for canned food." Support your critique with the principles of thermal death kinetics (D and Z values). | CO5 | E | 10 |
|  | b. | **Design**a downstream processing flowchart for the recovery and purification of a intracellular lipid from a bacterial biomass, specifying the purpose of each major unit operation. | CO5 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | **Assess** the impact of different freezing methods (e.g., slow freezing vs. individual quick freezing) on the viability of microbial cells and the quality of a frozen food product. | CO5 | E | 10 |
|  | b. | **Explain**the principle of lyophilization. | CO5 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | A new bacterial strain is isolated from a hot spring**. Propose** a strategy to determine its optimal growth temperature and pH. | CO2 | C | 10 |
|  | b. | **Compare** the information provided by a Transmission Electron Microscope (TEM) with that of a Scanning Electron Microscope (SEM) in the context of analyzing bacterial cell structure. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | **Formulate** a hypothesis for how a specific factor (e.g., oxygen concentration, osmotic pressure) influences the sporulation process in Bacillus species. | CO2 | C | 10 |
|  | b. | **Diagnose** the potential causes of contamination in a continuously operated bioreactor | CO4 | E | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | **Diagnose** a scenario where batches of a nutrient broth in a fermentor are consistently showing poor microbial growth. Systematically analyze the potential causes related to media composition, sterilization, and environmental conditions. | CO6 | E | 10 |
|  | b. | **Create** an integrated quality control plan for a facility producing a probiotic supplement, outlining the microbiological tests from raw material acceptance to final product release. | CO6 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | ***Implement*** the process of screening, developing, and maintaining industrial strains for practical applications |
| CO2 | ***Assess*** the selection of appropriate bacteriological media and nutritional requirements for optimal bacterial growth. |
| CO3 | ***Design*** effective methods for the preservation of bacteria |
| CO4 | ***Formulate*** an effective sterilization protocol for controlling microorganisms |
| CO5 | ***Evaluate*** the effectiveness of different food preservation techniques in maintaining food quality and safety and downstream processing. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25FP704** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCES IN FRUITS AND VEGETABLE PROCESSING TECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | A farmer's cooperative in a tropical region grows a mix of delicate berries. They are struggling with post-harvest losses and have asked for your expertise.  Propose a specific pre-cooling method for produce (berries) justifying your choice by linking it to the critical factors that determine pre-cooling efficiency. | CO1 | A | 10 |
|  | b. | The global fruit and vegetable processing industry is at a crossroads. Conduct a comprehensive SWOT analysis, focusing on the internal weakness and external threats. | CO6 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Design a hydrocooling system for a large-scale peach orchard. The design should include a schematic diagram and specify key operational parameters to prevent cross-contamination. | CO1 | A | 10 |
|  | b. | An apple storage facility in Kashmir is transitioning from regular cold storage to Controlled Atmosphere (CA) storage. Design a CA protocol for the 'Ambri' apple variety, specifying the target gas composition (O₂, CO₂, N₂), temperature, and humidity levels, and justify the specific combination mitigates physiological disorders. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Compare the operational principles, advantages, and limitations of form-fill-seal machines versus pre-formed tray MAP machines for packaging fresh-cut salad mixes. | CO5 | An | 10 |
|  | b. | Develop a critical control point (CCP) plan for the canning of pineapple slices, focusing specifically on the steps of syruping and thermal processing. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | A new startup's batch of mango juice has developed off-flavors and visible spoilage. Investigate the potential causes by categorizing them into chemical, enzymatic, and microbial spoilage. Synthesize a multi-hurdle preservation strategy to prevent such spoilage in future batches. | CO2 | An | 10 |
|  | b. | Propose a recipe and process for fermenting a traditional lemon pickle. The explanation should link each step (e.g., salting, sun-drying) to its biochemical role in preservation and flavor development. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | For developing an osmotically dehydrated pineapple product, design an experiment to investigate the effect of syrup concentration and temperature on the water loss and solid gain kinetics. Identify the dependent and independent variables for your experiment. | CO2 | A | 10 |
|  | b. | Develop a process flow chart for the production of a Litchi-based Ready-to-Serve (RTS) beverage. Then, critically evaluate your product formulation against the latest FSSAI standards for RTS to ensure compliance. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Evaluate the feasibility of using Freeze Concentration for concentrating carrot puree compared to standard evaporation. The analysis should weigh the superior product quality against the higher operational costs and technical complexity for an industrial application. Then, critically evaluate your product formulation against the latest FSSAI standards. | CO4 | An | 10 |
|  | b. | Propose a novel interactive packaging concept for a premium brand of fresh, whole avocadoes. The package should actively communicate ripeness to the consumer. Describe the mechanism and the material required. | CO5 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | A large-scale producer of fresh-cut lettuce is experiencing inconsistent cooling and high wilting losses with their forced-air cooling system. You are tasked with evaluating the switch to a vacuum cooling system. Design a basic schematic (line diagram) of a vacuum cooling system tailored for lettuce, labeling all key components. | CO1 | A | 10 |
|  | b. | Illustrate the process flow for Dragon fruit juice production. Create a detailed flowchart and then critically analyze the most likely point(s) in the process where significant nutrient (betalain) degradation or microbial contamination could occur, and propose a control measure for each. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | A commercial food processor wants to scale up the production of aseptically packaged papaya pulp. Analyze the technical challenges they might face during the heating and cooling phases of the aseptic process that could affect the pulp's viscosity and color. Propose engineering or process solutions to overcome these challenges. | CO2 | An | 10 |
|  | b. | Design a simple blanching protocol green beans (specifying time and temperature ranges) for each vegetable, explaining how your chosen parameters achieve the key objectives of blanching.  a) Justify the necessity of including a blanching step for these specific vegetables in the frozen product line. | CO6 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | A batch of guava jelly has failed to set properly and has developed a syrupy layer on top. You are hired as a consultant.  Diagnose the most likely causes for these two specific defects (failure to set and syrupy layer) and propose a corrective action plan for the current failed batch and a preventive control measure for future batches to avoid these defects. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge of different physical, chemical and nutritional properties of fruits and vegetables. |
| CO2 | Acquire insight into the various chemical and biochemical changes that occur during processing. |
| CO3 | Learn various ways of designing and monitoring processing chains |
| CO4 | Gain thorough knowledge about laws, regulations and the monitoring agencies involved in food safety and labeling of fruits and vegetables. |
| CO5 | Understand the methods of packaging, shelf life and related factors in the processing of fruits and vegetables. |
| CO6 | Know how fruits and vegetables are processed in industries. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25FP706** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED NUTRACEUTICALS AND FUNCTIONAL FOOD SYSTEMS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Classify nutraceuticals and functional foods based on their source, mechanism, and application. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the significance of nutraceuticals and functional foods in the management of chronic diseases such as diabetes or cardiovascular disorders. | CO1 | A | 20 |
|  |  |  |  |  |  |
| 3. |  | Define food fortification and explain the techniques used for fortifying foods with essential minerals and vitamins. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Classify dietary fibers and summarize their nutritional and physiological significance. | CO2 | U | 10 |
|  | b. | Examine the methods of incorporating dietary fibers into various foods and analyze their effect on texture and sensory attributes. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. |  | Describe the nutritional requirements of different target groups (infants, adults, pregnant women, elderly) and relate them to disease prevention. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Interpret the importance of dosage and bioavailability in determining the therapeutic efficacy and safety of nutraceutical compounds. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the principles and various methods of extraction, purification, and isolation of bioactive compounds from plant and food materials. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe different delivery mechanisms used for phytochemicals to improve stability and targeted release. | CO4 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Elucidate the concept and development of synbiotics, and analyze how their combined action enhances gut and systemic health. | CO5 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Evaluate the role of nutraceutical and functional foods in health and disease management. |
| CO2 | Choose the relevant food fortification techniques for applications in specialized nutrition. |
| CO3 | Evaluate the choice of bio-actives and micronutrients in promoting health. |
| CO4 | Evaluate the techniques used for effective delivery of bioactive compounds. |
| CO5 | Develop probiotics, and synbiotic for relevant health applications. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP707** | **Duration** | **3hrs** |
| **Course Title** | **NANOTECHNOLOGY IN FOOD APPLICATION** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Compare top-down and bottom-up synthesis approaches in relation to the classification of nanostructured materials. | CO1 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Differentiate Transmission Electron Microscopy (TEM) from Scanning Electron Microscopy (SEM) based on imaging mechanism and resolution. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Summarize the advantages and limitations of microencapsulation and nanoencapsulation for flavor delivery. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Compare conventional packaging with smart packaging in terms of functionality and consumer benefits. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain the role of nanoparticles in enhancing the performance of food packaging materials or sensors. | CO5 | A | 10 |
|  | b. | Compare active, smart, and nanocomposite packaging technologies in terms of functionality and application scope. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain nanoformulations for the delivery of bioactive compounds. | CO3 | A | 10 |
|  | b. | Explain the principle of Dynamic Light Scattering (DLS) for measuring particle size distribution, with a schematic diagram. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the principle behind the formation and stabilization of nano-emulsions. | CO3 | A | 10 |
|  | b. | Summarize recent innovations in biodegradable or bio-based smart packaging systems. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Compare amperometric, potentiometric, and conductometric sensors in terms of operating principle and application. | CO5 | An | 20 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain how carbon quantum dots enhance the sensitivity of nanosensors. | CO5 | A | 20 |
|  |  |  |  |  |  |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Evaluate general synthesis methods, including top-down and bottom-up approaches, for producing nanomaterials. |
| CO2 | Choose the relevant techniques for characterizing nanomaterials. |
| CO3 | Choose suitable technologies for the development of nanomaterials. |
| CO4 | Develop suitable nano packaging for food applications. |
| CO5 | Design nano sensors for food safety. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP708** | **Duration** | **3hrs** |
| **Course Title** | **EXTRUSION TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain in detail the rheological classification of fluids with graph. | CO1 | U | 10 |
|  | b. | Describe the different rheological models used to represent non-Newtonian fluid behavior with diagrams. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the design of different types of viscometers. | CO1 | U | 10 |
|  | b. | Give in detail the working principle and applications of rotational rheometers. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the **working design and classification of food extruders** with diagrams. | CO2 | U | 10 |
|  | b. | Describe the types of packaging materials suitable for extruded food products and their importance. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Categorize the chemical and nutritional changes that occur in food during extrusion. | CO2 | A | 10 |
|  | b. | Discuss the **design considerations and operational parameters** for achieving consistent extrusion output. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the importance of texture analysis in evaluating extruded food products. | CO3 | U | 10 |
|  | b. | Compare cold and hot extrusion of food products in terms of product quality and applications. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the role of high shear cooking in the extrusion of food products. | CO3 | U | 10 |
|  | b. | Discuss the applications of extrusion in pet food and animal feed production. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Describe the construction and applications of single-screw and twin-screw extruders. | CO4 | U | 10 |
|  | b. | Discuss the significance of raw material properties in extrusion design and product quality. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Write short notes on flavor formation and retention during extrusion cooking. | CO4 | A | 10 |
|  | b. | Discuss the properties of food materials that influence extrusion equipment design. | CO4 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the classification of breakfast cereals and the raw materials used for their manufacture. | CO5 | U | 10 |
|  | b. | Describe the role of extrusion technology in confectionery production with advantages. | CO5 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate the rheological properties of food materials. |
| CO2 | Choose the extrusion processes and their effects on food product properties. |
| CO3 | Evaluate the food texturization components and process conditions during extrusion. |
| CO4 | Choose the suitable extrusion equipment for diverse food applications. |
| CO5 | Evaluate the advanced extrusion technologies in modern food product development. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP709** | **Duration** | **3hrs** |
| **Course Title** | **WASTE VALORIZATION IN FOOD INDUSTRY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Analyze the various classification systems for food waste (e.g., by source, composition, biodegradability) and construct a comparative chart that critiques the utility of each system for different waste management strategies. | CO2 | An | 10 |
|  | b. | Criticizethe Eco-mark scheme within the framework of ISO 14001:2015 and assess its effectiveness as a tool for promoting sustainable consumption. | CO6 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Develop a standardized procedure to calculate the carbon footprint of food waste within a specific sector (e.g., a retail chain or a university campus). | CO5 | A | 10 |
|  | b. | Comparethe legal frameworks for handling food waste in two different regulatory environments. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the pyrolysis process for a specific type of food waste (e.g., nut shells or mixed plastics from packaging). | CO5 | A | 10 |
|  | b. | Design a conceptual diagram for a co-digestion biogas plant that uses food waste and agricultural residues. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Interpret the critical factors involved in Solid-State Fermentation (SSF) for enzyme production. | CO4 | A | 10 |
|  | b. | Illustrate the incineration process as a waste-to-energy solution for high-calorific food waste. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Assess the current regulatory standards for drinking water in your country against the WHO guidelines and critique the stringency of the parameter for a specific standard (e.g., for a heavy metal) based on recent scientific evidence. | CO1 | E | 10 |
|  | b. | Interpret the mechanism of the flocculation process in wastewater treatment. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Weigh the advantages and disadvantages of solid-state fermentation against submerged fermentation for the production of a high-value secondary metabolite. | CO5 | E | 10 |
|  | b. | Propose an integrated valorization strategy for the primary waste generated from the potato processing industry. The strategy should categorize the waste streams (peels, starch-laden water, etc.). | CO4 | C | 10 |
|  |  |  |  |  |  |
| 7. | a. | Design a labeled schematic of the floatation tank that includes the necessary components to mitigate problem occurring due to high BOD5 value and explain the functional role of each component. | CO3 | A | 10 |
|  | b. | Develop a detailed flowchart for the recovery of soluble and insoluble dietary fiber from fruit pomace and justify the sequence of unit operations. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Differentiate the biochemical processes occurring in aerated lagoons versus facultative lagoons. | CO3 | An | 10 |
|  | b. | Analyze the efficiency of an ozonation system for the removal of specific recalcitrant organic compounds from wastewater by explaining its mechanism. | CO3 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Develop a comprehensive life cycle assessment (LCA) report for the carbon footprint of the meat processing industry. The report should categorize the major emission hotspots across the supply chain (feed production, enteric fermentation, processing, and distribution). | CO6 | A | 10 |
|  | b. | Design a process flow diagram for the recovery of lactose from dairy industry wastewater and critique the technical and economic challenges of the crystallization and purification steps. | CO4 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Identify sources of potable water. |
| CO2 | Identify the origin of waste generated in food industries. |
| CO3 | Summarize various methods of treating water and food wastes. |
| CO4 | Demonstrate co-product recovery from food waste. |
| CO5 | Decide on suitable food waste resources management strategies. |
| CO6 | Develop pollution prevention mechanisms. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25FP710** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED INSTRUMENTAL TECHNIQUES OF FOOD ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the types of samples used in analytical procedures with examples. | CO1 | R | 10 |
|  | b. | Differentiate between univariate and multivariate data analysis methods with examples. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the analytical procedure from sample collection to data interpretation with a flowchart. | CO1 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Discuss in detail the principle and application of FTIR in determining the functional group present in the sample. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain how FTIR spectroscopy is used in the identification of functional groups in food compounds. | CO2 | An | 10 |
|  | b. | Differentiate between NIR, MIR, and FTIR spectrometers in terms of working principle and applications. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Interpret the role of shielding and deshielding groups on the chemical shift in NMR with examples. | CO3 | A | 10 |
|  | b. | List the major limitations of NIR and MIR spectroscopy in food analysis. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Compare and contrast 13C and 1H NMR in determining the structure of the given compound. | CO3 | E | 10 |
|  | b. | Explain the MRI zused in food texture and structure analysis. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Describe the design of an E-nose system with a neat diagram. | CO4 | U | 10 |
|  | b. | Evaluate the challenges and limitations of E-nose technology in food analysis. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the basic working principle of Electronic Nose (E-nose) | CO4 | U | 10 |
|  | b. | Write a short note on the integration of IoT with E-nose technology. | CO4 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the signal processing and pattern recognition steps in E-tongue data analysis. | CO5 | An | 10 |
|  | b. | Discuss recent advancements in E-tongue technology and its applications. | CO5 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Choose the relevant method of sample preparation relevant to the method of analysis. |
| CO2 | Evaluate the suitability of NIR, MIR and Raman spectroscopy for analysis of Food samples. |
| CO3 | Evaluate the quality of food products using NMR and MIR. |
| CO4 | Develop novel flavor compounds using e-nose technology |
| CO5 | Develop novel compounds of varying tastes using e-tongue technology |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP711** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED PACKAGING TECHNOLOGIES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the major functions of packaging in food systems with examples. | CO1 | A | 10 |
|  | b. | Analyze the effect of internal and external factors on quality of packaged food. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Differentiate between accelerated shelf-life test and normal shelf-life test. | CO1 | An | 5 |
|  | b. | Predict the shelf-life of orange juice using accelerated shelf-life test. | CO1 | A | 15 |
|  |  |  |  |  |  |
| 3. | a. | Compare vacuum packaging and inert gas packaging in terms of mechanism and uses. | CO2 | An | 10 |
|  | b. | Evaluate different testing methods for packaging materials, focusing on mechanical strength and transmission rates. | CO2 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write the properties and specific applications of copolymers and co-extruded films in the food industry. | CO2 | A | 10 |
|  | b. | Assess the structure and uses of laminated paperboard cartons for liquid and solid foods. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the roles of nanocomposites in packaging for emphasizing oxygen scavenging and antimicrobial functions. | CO3 | A | 10 |
|  | b. | Examine the use of edible coatings for minimally processed foods and their impact on shelf-life. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Assess the emerging trends in active packaging technologies for improved food safety. | CO3 | An | 10 |
|  | b. | Criticize the challenges in adopting active packaging in commercial food industries. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the methodology and importance of Life Cycle Assessment (LCA) in food and beverage packaging. | CO4 | An | 10 |
|  | b. | Evaluate the role of packaging in reducing food waste and its environmental implications. | CO4 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Critically evaluate current innovations in sustainable packaging for food. | CO4 | E | 10 |
|  | b. | Summarize the future directions and opportunities for eco-packaging in the global food industry. | CO4 | E | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Analyze the freshness and safety indicators in intelligent packaging solutions. | CO5 | An | 10 |
|  | b. | Explain the tamper evidence concepts along with the applications in food packs for consumer assurance. | CO5 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate the functions of food packaging systems and environmental stressors affecting shelf life |
| CO2 | Evaluate the appropriate advanced packaging materials based on specific food product characteristics and functional requirements. |
| CO3 | Create innovative strategies for food preservation and functionality enhancement. |
| CO4 | Design sustainable, eco-efficient packaging solutions using Life Cycle Assessment (LCA) and related environmental impact evaluation tools. |
| CO5 | Develop intelligent packaging systems incorporating sensors and indicators for food safety and traceability |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP712** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED COMPUTATIONAL METHODS IN FOOD QUALITY ASSESSMENT AND PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| PART – A (4 X 20 = 80 MARKS)  (Answer all the Questions) | | | | | |
| 1. | a. | Explain the role of intelligence and data analytics in IoT-driven food quality and processing systems. | CO1 | An | 10 |
|  | b. | Compare and contrast machine learning and deep learning approaches, highlighting major differences and their respective roles in food applications. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Examine how standards in IoT contribute to interoperability and scalability in food industry solutions. | CO1 | A | 10 |
|  | b. | Summarize the future challenges and opportunities for integrating deep learning with IoT in food processing technology. | CO1 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the architecture and functioning of feed forward neural networks (FNN) used for food quality prediction and classification. | CO2 | A | 10 |
|  | b. | Explain the steps involved in training, validation, and testing of FNN models for predicting food quality using Python | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the structure and operational workflow of convolutional neural networks (CNN) in food image analysis tasks. | CO2 | An | 10 |
|  | b. | Analyze the importance and methods of image acquisition systems in computer vision for food processing. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Evaluate the IoT devices contribute to improved assessment of cooked meats, poultry carcasses, and seafood quality | CO3 | E | 10 |
|  | b. | Explain the process of implementing IoT-enabled monitoring systems for animal product assessment. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Summarize the role of sensors and data analytics in food safety and traceability for animal-based products. | CO3 | E | 10 |
|  | b. | Illustrate application of deep learning models in image-based quality grading of meat and seafood | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Propose a framework for IoT-enabled grading and sorting of plant-based products for industry adoption | CO4 | C | 10 |
|  | b. | Evaluate the effectiveness of IoT-driven systems for real-time monitoring of produce storage and transportation. | CO4 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Apply deep learning techniques for automated classification of apples, citrus, or vegetable varieties based on quality images. | CO4 | A | 10 |
|  | b. | Predict future trends in the use of advanced technologies for sustainable plant-based food quality assurance | CO4 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate approaches for personalized food processing and how customized nutrition can be achieved for different populations. | CO5 | A | 10 |
|  | b. | Propose solutions to address emerging sustainability challenges in smart packaging and food technologies for future food systems | CO5 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate the foundational principles and technological infrastructure of IoT and Deep Learning |
| CO2 | Develop Feedforward and Convolutional Neural Network models using Python to perform classification and prediction tasks in food quality assessment |
| CO3 | Evaluate the quality of meat, poultry, and seafood products using IoT sensors and Deep Learning models. |
| CO4 | Evaluate the quality of fruits and vegetables using IoT-enabled systems and vision-based Deep Learning techniques. |
| CO5 | Design smart packaging solutions for sustainable food systems. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25FP713** | **Duration** | **3hrs** |
| **Course Title** | **FLAVOUR SCIENCE AND TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Evaluate the neural overlap between pain and chemesthetic pathways and its implications for food design. | CO1 | E | 10 |
|  | b. | Evaluate the role of taste pathways in guiding nutrient intake and toxin avoidance. | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Design a bio-inspired fragrance delivery system using OBP principles. | CO1 | C | 20 |
|  |  |  |  |  |  |
| 3. | a. | Evaluate the role of pH and temperature in modulating the formation of sulfur-containing volatiles during Maillard reactions. | CO2 | E | 10 |
|  | b. | Evaluate the role of protein–flavour interactions in the sensory performance of plant-based meat analogues. | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Evaluate the effectiveness of rational odorant design in improving consumer acceptance of plant-based meat analogues. | CO2 | E | 20 |
|  |  |  |  |  |  |
| 5. |  | Design a sensory protocol to compare the flavor release of two encapsulated flavor systems in a dairy beverage. | CO3 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Assess the ethical and practical challenges of interpreting qualitative data in sensory research. | CO3 | E | 20 |
|  |  |  |  |  |  |
| 7. |  | Propose a clean-label HVP formulation strategy for a vegan bouillon cube with minimal salt and no MSG. | CO4 | C | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Develop a regulatory checklist for formulating a globally compliant natural flavour blend for a ready-to-drink herbal infusion. | CO4 | C | 20 |
|  | b. |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Assess the role of AI-driven flavour design in reducing formulation time and enhancing personalization in functional foods. | CO5 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Choose relevant flavour for specific foods based on sensory perception. |
| CO2 | Design suitable flavour compounds specific to the relevant food systems. |
| CO3 | Apply sensory evaluation techniques and consumer research tools to assess flavour attributes and optimize food product development. |
| CO4 | Design flavour systems through blending, enhancement, and masking techniques suited for specific food matrices. |
| CO5 | Apply AI/ML tools and IoT-enabled systems for flavour innovation and quality assurance. |