CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

**FACULTY OF ENGINEERING & TECHNOLOGY**

**Effective from Academic Batch: 2022-23**

**Programme:** **Master of Technology (Food Technology)**

**Semester:** **2**

**Course Code:** **202380201**

**Course Title:** **Advanced Food Engineering Operations**

**Course Group:** **Core Course III**

**Course Objectives:**

1. To illustrate various aspects of food engineering operations and to develop understanding about thermal processing, distillation, leaching, extraction, crystallization, mixing, filtration and membrane processing.

**Teaching & Examination Scheme:**

| Contact hours per week | | | Course Credits | Examination Marks (Maximum / Passing) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | J/V/P* | | Total |
| Lecture | Tutorial | Practical | | Internal | External | Internal | External | |
| 3 | 0 | 2 | 4 | 50/20 | 50/20 | 25/10 | 25/10 | 150/60 |

* **J**: Jury; **V**: Viva; **P**: Practical

**Detailed Syllabus**

| Sr. | Contents | Hours |
|---|---|---|
| 1 | Thermal processing: Concept of Microbial inactivation, F-Value, Thermal Resistance, Commercial Sterility, Probability of Spoilage and Lethal Rate. Thermal Process Time Calculations, Formula Method, Factors Affecting Time of Thermal Process, Calculation of Process Time in Continuous Flow System. | 7 |
| 2 | Distillation: Flash distillation, Batch distillation, Continuous distillation with reflux, Distillation in packed column, Application of distillation in food industry. | 6 |
| 3 | Leaching: Principle of Continuous Countercurrent leaching. Extraction: Principle of extraction. Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment used in NCF extraction and industrial application. | 7 |
| 4 | Crystallization: Crystal geometry, Equilibria and Yields, Nucleation, Crystal growth, Crystallization Equipment. Mixing of solid: Measure of mixer performance. Mixing of liquid: Flow pattern of liquid in agitated vessel, Flow number, Power consumption in mixing | 7 |

| | | |
|---|---|---|
| **5** | Filtration: Principle of cake filtration, Compressible and Incompressible filter cakes, Constant pressure filtration, Constant rate filtration. Membrane Technology: Pressure activated membrane processes. Permeate and solute flux for MF, UF and RO, Concentration Polarization. | **8** |

**List of Practicals / Tutorials:**

| | |
|---|---|
| **1** | Numerical Problems on D, F, Z value and spoilage probability |
| **2** | Numerical Problems on thermal process time calculation for different food products. |
| **3** | Problems on flash distillation, batch distillation, Rayleigh Equation |
| **4** | Numerical Problems on Continuous distillation with reflux |
| **5** | Numerical Problems on continuous Countercurrent leaching |
| **6** | Numerical Problems on extraction and SCFE |
| **7** | Numerical Problems on Crystallization, Equilibria and Yields |
| **8** | Numerical Problems on solid and liquid mixing |
| **9** | Numerical Problems on Constant pressure filtration, Constant rate filtration |
| **10** | Numerical Problems on Permeate and solute flux for MF, UF and RO |
| **11** | Open Ended Problem on application of the concepts of process time calculation, distillation column |

**Reference Books:**



| | |
|---|---|
| **1** | Geankoplis J Christie. 1999. Transport Process and Unit Operations. Allyn& Bacon. |
| **2** | McCabe WL & Smith JC. 1999. Unit Operations of Chemical Engineering. McGraw Hill. |
| **3** | Singh RP and Heldman DR. 1993.Introduction to Food Engineering. Academic Press |
| **4** | Coulson JM & Richardson JF. 1999. Chemical Engineering. Vol. II, IV. The Pergamon Press. |
| **5** | Fellows P. 1988. Food Processing Technology: Principle and Practice. VCH Publ. |
| **6** | R.T. Toledo , Fundamentals of Food Process Engineering |
| **7** | Brennan JG, Butters JR, Cowell ND & Lilly AEI. 1990. Food Engineering Operations. Elsevier. |



**Supplementary learning Material:**

| | |
|---|---|
| **1** | www.onlinelibrary.wiley.com/journal/10.1111/(ISSN)1365-2621 |
| **2** | www.journals.elsevier.com/lwt-food-science-and.../open-access-articles |

**Pedagogy:**

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Industrial/ Field visits
- Course Projects

**Internal Evaluation:**

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

| Distribution of Theory Marks | | | | | | **R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create |
|---|---|---|---|---|---|---|
| **R** | **U** | **A** | **N** | **E** | **C** | |
| 15 | 20 | 20 | 20 | 25 | 0 | |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Course Outcomes (CO):**

| Sr. | Course Outcome Statements | %weightage |
|---|---|---|
| **CO-1** | Understand the microbial inactivation and thermal processing of food. Ability to calculate the process time for food. | **20** |
| **CO-2** | Acquaintance with the distillation, leaching and extraction principles and equipments and its application in food industry. | **36** |
| **CO-3** | Develop the concept of crystallization process and mixing of solid and liquid foods | **20** |
| **CO-4** | Ability to solve problems of filtration and membrane process | **24** |

| **Curriculum Revision:** | |
|---|---|
| Version: | 2.0 |
| Drafted on (Month-Year): | June-2022 |
| Last Reviewed on (Month-Year): | - |
| Next Review on (Month-Year): | June-2025 |