M. TECH FOOD TECHNOLOGY SEMESTER I

w.e.f. July 2018

M. TECH. FOOD TECHNOLOGY SEMESTER I STUDY & EVALUATION SCHEME

Ist Year

I Semester

| | Course | | | | Periods | | Ev | valua | tion Sc | heme | | |
|-----------|---------|--------------------|---|------|---------|---|----------------|-------|---------|-------|------------------------|---------|
| Sl. No | Categor | Subject | Name of the Subject | | | | Sessional (CA) | | | End | Subject | |
| | У | Code | | L | Т | Р | С | СТ | TA | Total | Sem. Exam. (ESE) | Totai |
| 1. | DC | BE-550 | Fundamental Food Microbiology | 2 | 1 | 0 | 3 | 25 | 15 | 40 | 60 | 100 |
| 2. | DC | BE-551 | Introduction to Food Engineering | 3 | 1 | 0 | 4 | 25 | 15 | 40 | 60 | 100 |
| 3. | DC | BE-552 | Principles of Food Chemistry | 2 | 1 | 0 | 3 | 25 | 15 | 40 | 60 | 100 |
| 4. | DC | BE-553 | Food Processing Technology | 3 | 1 | 0 | 4 | 25 | 15 | 40 | 60 | 100 |
| 5. | DC | B3-554 | Food Analysis & Quality Control | 3 | 1 | 0 | 4 | 25 | 15 | 40 | 60 | 100 |
| Practical | | | | | | | | | | | | |
| 9. | DC | BE-555 | Quality Control Lab | 0 | 0 | 6 | 3 | 30 | 30 | 60 | 40 | 100 |
| | , | Fotal | | 12 | 5 | 6 | 21 | 155 | 105 | 260 | 340 | 600 |
| L - L | ecture | $\mathbf{T} - Tut$ | orial \mathbf{P} – Practical \mathbf{C} – | Cred | its | | СТ | – Cla | ss Te | st | TA - | Teacher |

Assessment

Sessional Total (CA) = Class Test + Teacher Assessment

Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

BS – Basic Sciences, DC – Departmental Core, HM – Humanities, OE – Open Elective, DE – Departmental Elective,

ESA – Engineering Sciences & Arts (Foundation Course & Engineering Courses)

BE-550 FUNADAMENTAL FOOD MICROBIOLOGY

| Pre-requisite | Co-requisite | L | Τ | Р | С |
|---------------|--------------|---|---|---|---|
| BE-550 | None | 2 | 1 | 0 | 3 |

Objective: This subject aims is to give students an understanding of microbial growth as well as the spoilage and the safety of the foods.

| UNIT I | Introduction | 8 |
|----------|---|---|
| | Introduction: Historical development, Discovery of microbial world. | - |
| | Biogenesis, abiogenesis controversy, germ theory of disease, | |
| | immunization, chemotherapy, discovery of viruses, applied microbiology, | |
| | Microbiology in twentieth century. General characteristics of bacteria, | |
| | yeast, mold, viruses and algae. Brief account of bacterial, yeast and mold | |
| | reproduction. | |
| UNIT II | Microbial Growth | 8 |
| | Microbial growth and reproduction; Definition of growth, growth curve, | |
| | growth rate, generation time, measurement of growth, effect of | |
| | environmental factors such as temperature, moisture, salt, pH, oxidation | |
| | reduction potential and radiation on growth. Control of microorganisms by | |
| | physical, chemical and biological agents, thermal death time, Z, F and D | |
| | values. | |
| UNIT III | Prevention of Microbial Growth | 8 |
| | Sources and prevention of contamination. General principles of food | |
| | preservation. Microbiology of air, water, milk products; cereals and cereal | |
| | products; meat and meat products, fish and fish products; poultry and eggs; | |
| | spices and condiments; canned foods. | |
| UNIT IV | Microbial Techniques | 8 |
| | Microbial techniques; Isolation and preservation of microbial cultures | |
| | (Brief introduction). Methods of genetic improvement (Recombinant DNA | |
| | Technology). Bacterial toxins and mycotoxins with special reference to | |
| | Staphylococcus, Clostridium, Aspergillus. Food poisoning and safety | |
| | measures. | |

References

- 1. Dubey, R.C., and Maheshwari, D. K. (2001). A text book of microbiology, S. Chand and Co., New Delhi.
- Pelezar, M. J., Chan, E. G. S. and Krieg, N.R. (2002). , Microbiology 5th edition, Tata McGraw Hill and Co, 2. New Delhi.
- 3. Purohit, S. S. (2001). Microbiology, Fundamentals and applications.
- 4. Sharma, P.D. (2000). *Microbiology*, A text book for university students.
- 5. Frazier, W. C. & Westhoff, D. C. (1996). Food Microbiology, Tata McGraw Hill and Co.
- 6. James, M.J. (1997). Modern Food Microbiology, 4th Edition, CBS Publishers, New Delhi
- 7.
- Barnart, G.J. (1997). *Basic Food Microbiology*, CBS Publishers, New Delhi. Stainer, R.Y. (1996). General Microbiology, 5th edition, Mac Millan Publishers, New Delhi. 8.

BE-551 INTRODUCTION TO FOOD ENGINEERING

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| BE-551 | None | 3 | 1 | 0 | 4 |

Objective: This course is aimed to impart basic knowledge about food engineering processes and unit operations associated with them.

| UNIT I | Fluid MechanicsProperties of liquids, Handling systems for Newtonian liquids, Bernoulli equation, Energy equation for steady flow of liquids, Pump Selection and performance | 8 |
|----------|---|---|
| UNIT II | Mass Transfer IPrinciple of Mass Transfer, Diffusion, Molecular diffusion in fluids, Theories of mass transfer. Application of Mass Transfer in Foods. Rheology of solid foods. | 8 |
| UNIT III | Mass Transfer II Distillation, Liquid-liquid extraction, Liquid-liquid extraction equipment, Leaching: Introduction, Principles of continuous-counter current leaching. Gas liquid extraction. | 8 |
| UNIT IV | Heat Transfer I Heat transfer- mode of heat transfer. Steady and unsteady heat transfer, thermal process calculation. Heat transfer equipment | 8 |
| UNIT V | Heat Transfer II Thermal operations: Pasteurization and Sterilization, Freezing, Freeze concentration of liquid food. Concentration and Evaporation | 8 |

References

Books

1. Sahay, K.M. and Singh, K. K. 1998. Unit Operations of Agricultural Processing by Kalya Publishers, Ludhiana.

2. Lloyd, A. & Penizer, R. 2006. Handling, Transportation and storage of Fruits and Vegetables, AVI Publications, UK.

3. Mcabe W. L. and Smith J. C. 2005. Unit operations of chemical engineering. Mc Graw Hill Publication.

4. Gean Koplis C. J. (3rd Edition). Transport processes in unit operations. Prentice Hall of India.

5. P.Fellows. 2000. Food processing technology. Principles and practice. Ellis Horwood England and V C H publishers Germany

6. Earl, P. 1994. Unit operation in Food Processing, Elsevier Science UK.

BE-552 PRINCIPLES OF FOOD CHEMISTRY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| BE-552 | None | 2 | 1 | 0 | 3 |

Objective: This subject aims is to give students an understanding of the properties of food constituents, and the interactions between these constituents during food processing, storage and digestion. Students will gain an appreciation of the relationship between chemical composition and properties of macroconstituents (carbohydrates, proteins, lipids) and microconstituents (vitamins, minerals, antioxidants, flavour and anti-nutritional chemicals) and their functions in plant- and animal-based foods.

| UNIT I | Water | 8 |
|----------|--|---|
| | Physical properties of water. Structure of water molecule. Water-Solute Interactions. Sorption phenomena. Types of water in foods. Freezing and ice structure. Water activity and relative vapour pressure. Water activity and food spoilage. | |
| UNIT II | Carbohydrates and Lipids | 8 |
| | Structure and functional properties of mono-, oligo-, & polysaccharides including starch, cellulose, pectic substances and dietary fibre, gelatinization and retrogradation of starch. | |
| | Classification and structure of lipids, Autoxidation, photooxidation, rancidity and flavour reversion, Hydrogenation and interesterification. Physical properties of fats. Cocoa butter and confectionary fats. Novel oils and fats. Fat replacers. | |
| UNIT III | Proteins and Enzymes | 8 |
| | Classification and structure of proteins in food, Functional properties, Protein denaturation. Nonenzymatic browning. Animal proteins. Plant proteins. Enzymes: specificity, simple and inhibition kinetics, coenzymes, enzymatic browning. | |
| UNIT IV | Pigments and Flavours | 8 |
| | Carotenoids, chlorophylls, anthocyanins, tannins and myoglobin. Food flavours: Taste and nonspecific saporous sensations. Vegetable, fruit and spice flavours. | |

References

^{1.} Chopra, H.K and Panesar, P.S. "Food Chemistry", Narosa, 2010

^{2.} Damodaran, S., Parkin, K.L. and Fennema, O.R. "Food Chemistry", 4th Edition, CRC /

Taylor & Francis, 2008

^{3.} Belitz, H.D., Grosch, W and Schieberle, P. "Food Chemistry", 3rd Edition, Springer, 2004

^{4.} Walstra, P. "Physical Chemistry of Foods", Marcel Dekker, 2003

BE-553 FOOD PROCESSING TECHNOLOGY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| BE-553 | None | 3 | 1 | 0 | 4 |

Objective: This course is about the basic principles and practices that help in preserving the foods.

| UNIT I | Basic Principles | 8 |
|----------|---|---|
| | Introduction and Historical Development of Food Preservation. Preservation by | |
| | heat; Principles of heat preservation, heat resistance of microorganisms and their | |
| | spores. Thermal death time; Heat treatments- boiling, steam under pressure, | |
| | pasteurization, canning; Heat penetration studies. | |
| UNIT II | Preservation by Low Temperature and Drying | 8 |
| | Preservation by low temperature- Low temperature storage, refrigeration and freezing. Preservation by drying; Phenomenon and methods of drying-dehydration by air drying, sun drying and freeze drying. | |
| UNIT III | Food Additives | 8 |
| | Preservation by food additives- antibiotics, chemicals, organic acids. | |
| | Preservation by radiations; Ultraviolet and ionizing irradiations. Their | |
| | effect on microorganisms, use in the treatment of food. | |
| UNIT IV | Novel Techniques | 8 |
| | Microwave heating- Properties, mechanism, microwave generator and | |
| | microwave food application. Introduction to hydrostatic pressure | |
| | technology, ohmic heating and extrusion cooking. Use of ultrasounds and | |
| | magnetic fields in food processing. | |
| UNIT V | Other Techniques | 8 |
| | Preservation by fermentation- Definition, Advantages, disadvantages, | |
| | types, equipment. Hurdle technology: concept and advantages. | |
| | Intermediate moisture foods. | |

References

Books

1. Sahay, K.M. and Singh, K. K. 1998. Unit Operations of Agricultural Processing by Kalya Publishers, Ludhiana.

Lloyd, A. & Penizer, R. 2006. Handling, Transportation and storage of Fruits and Vegetables, AVI Publications, UK.
P.Fellows. 2000. Food processing technology. Principles and practice. Ellis Horwood England and V C H publishers Germany

4. Earl, P. 1994. Unit operation in Food Processing, Elsevier Science UK.

5. Potter & Hotchkiss. Food Science, CBS Publishers, 2007

BE-554 FOOD ANALYSIS AND QUALITY CONTROL

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| BE-554 | None | 3 | 1 | 0 | 4 |

Objective: This subject aims is to give students an understanding of laboratory testing which is important for the scientific analysis to identify problems with food products, to compliance with regulations, research and development of new products.

| UNIT I | Proximate Composition | 8 |
|----------|---|---|
| | Sampling, Moisture, Ash and mineral matter, Titrable acidity, Crude fat, Sugar, Crude protein, Crude fibre, Starch. | |
| UNIT II | Microbiological Examination | 8 |
| | Basic Microbiological Techniques; Cultivation, Pure Culture Technique. Enumeration of Microorganisms; Dilution, Methods of counting microorganisms, Pour Plate and spread plate methods, Most probable number technique, Turbidity, Metabolic activity, Dry mass. Testing Methods for Quality and Safety; Total plate count, Yeast and mould count, Pathogens, Indicator microorganisms. | |
| UNIT III | Sensory Evaluation | 8 |
| | Quality, Laboratory set-up and equipment, Panel selection, Judging quality, Paired comparison test, Duo-Trio test, Triangle test, Ranking test, Hedonic rating test. | |
| UNIT IV | Objective Analysis | 8 |
| | UV-VIS molecular absorption spectrometry, atomic absorption spectrometry, HPLC, GC, Super critical fluid extraction, chromatography, Texture analysis, Colour analysis | |
| UNIT V | Quality Control and network analysis | 8 |
| | FSSA – 2006, BIS – 1952, Agmark – 1937, FPO – 1955, PFA – 1954, ISO – 9000 series, ISO 22000, Codex Alimentarius, Total Quality Management, Hazard Analysis Critical Control Point, PERT and CPM network, Six Sigma | |

References

- 2. Pomeranz, Y. and Meloan, C. E. (1996). Food Analysis: Theory and Practice (3 ed.): CBS Publications, New Delhi.
- 3. Winton, A. L. (2001). Techniques of Food Analysis: Agrobios, Jodhpur.
- 4. Sharma, B. K. (1994). Instrumental Methods of Chemical Analysis: Krishna, Meerut.
- 5. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). Principles of Instrumental Analysis (5 ed.): Harcourt, Singapore.
- 6. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). Elements of Analytical Chemistry: Sultan Chand & Sons

^{1.} Pare, J. R. J. and Bélanger, J. M. R. (2015). Instrumental Methods of Food Analysis: Elsevier

BE-555 Quality Control Lab

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | BE-554 | 0 | 0 | 6 | 3 |

1. Determination of moisture content of a given food sample

2. Determination of mineral content of a given food sample

3. Determination of Titrable acidity of a given food sample

4. Determination of crude fat of a given food sample

5. Determination of reducing and non-reducing sugar content of a given food sample

6. Determination of crude protein of a given food sample

7. Determine the threshold value of any flavour

8. Duo-Trio test and Triangle test

9. Rate any food sample by using Hedonic rating test

10. Determine yeast and mold count of a given food sample

11. Determine total plate count of a given food sample

12. Market analysis of various food as per governing standards

M. TECH FOOD TECHNOLOGY SEMESTER II

w.e.f. January 2019

M. TECH. FOOD TECHNOLOGY SEMESTER II STUDY & EVALUATION SCHEME

Ist Year

II Semester

| | G | | | | Periods | | | Evaluation Scheme | | | | |
|---------------------------|-----------|---------|---|------|---------|---|----------------|-------------------|-------|-------|------------------------|---------|
| Sl. No | Categor | Subject | Name of the Subject | 0 | | | Sessional (CA) | | | End | Subject | |
| | У | Code | | L | Т | Р | С | СТ | ТА | Total | Sem. Exam. (ESE) | Totai |
| 1. | DC | BE-556 | Unit Operations in Agricultural Processing | 3 | 1 | 0 | 4 | 25 | 15 | 40 | 60 | 100 |
| 2. | DC | BE-557 | Milk and Milk Products Technology | 3 | 1 | 0 | 4 | 25 | 15 | 40 | 60 | 100 |
| 3. | DC | BE-558 | Post-Harvest Technology | 2 | 1 | 0 | 3 | 25 | 15 | 40 | 60 | 100 |
| 4. | DC | BE-559 | Engineering Properties & Food Storage Technology | 2 | 1 | 0 | 3 | 25 | 15 | 40 | 60 | 100 |
| | DE | BE-562 | Food Biotechnology | 2 | | 0 | | 25 | 15 | 40 | 60 | |
| | | BE-563 | Introduction to | | | | | | | | | |
| ~ | | | Bioinformatics | | 1 | | 2 | | | | | 100 |
| 5. | | BE-564 | Fermentation technology | | 1 | | 3 | | | | | 100 |
| | Practical | | | | | | | | | | | |
| 9. | | BE-560 | Food Processing Lab | 0 | 0 | 6 | 3 | 30 | 30 | 60 | 40 | 100 |
| | , | Total | | 12 | 5 | 6 | 20 | 155 | 105 | 260 | 340 | 600 |
| $\mathbf{L} - \mathbf{L}$ | ecture | T - Tut | orial \mathbf{P} – Practical \mathbf{C} – | Cred | its | | CT | – Cla | ss Te | st | TA – | Teacher |

Assessment

Sessional Total (CA) = Class Test + Teacher Assessment

Subject Total = Sessional Total (CA) + End Semester Examination (ESE)

BS – Basic Sciences, DC – Departmental Core, HM – Humanities, OE – Open Elective, DE – Departmental Elective,

ESA – Engineering Sciences & Arts (Foundation Course & Engineering Courses)

BE-556 UNIT OPERATIONS IN AGRICULTURAL PROCESSING

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | None | 3 | 1 | 0 | 4 |

Objective: This course is aimed to impart basic knowledge about components of different process equipment and unit operation associated with them.

| UNIT I | Preliminary Unit Operations | 8 |
|----------|--|---|
| | Cleaning, sorting and grading - aims, methods and applications, physical | |
| | properties of food materials. Conveying and Handling: Study of different | |
| | conveying systems like belt conveyors, chain conveyors, screw conveyors, | |
| | selection operation and maintenance | |
| | selection, operation and maintenance. | |
| UNIT II | Size Reduction and Sieve Analysis | 8 |
| | Theory of commination, size reduction laws- calculation of energy required | |
| | during size reduction, size reduction equipment's: Crushers - grinders, ultrafine | |
| | grinders, cutters, size enlargement. Effects of size reduction on sensory | |
| | characteristics and nutritive value of food. Sieving, separation based on size | |
| | (mesh size), Types of screens: stationary screens – grizznes, gyrating screens, | |
| | violatory screens, and creetiveness of screens. | |
| UNIT III | Mixing & Agitation | 8 |
| | Liquid mixing, mixing equipments-liquid mixer, powder & particle mixer, | |
| | dough & paste mixer, jet mixer, static mixer, purpose of agitation, agitated | |
| | vessels - impellors, propellers & turbines, kneading, Homogenization - | |
| | Principle & equipment. | |
| UNIT IV | Separation Process | 8 |
| | Filtration-principle of filtration; types of filtration. Equipment- filter press, rotary | |
| | drum, shell & leaf filter, vacuum filter, centrifugal filter, filter media, filter aid, | |
| | filter cake. | |
| UNIT V | Other Operations | 8 |
| | Ultrafiltration, membrane filtration, reverse osmosis. Sedimentation- | |
| | Stoke's law. Free and hindered settling. Crystallization, nucleation, crystal | |
| | growth. | |

References Books

^{1.} Sahay, K.M. and Singh, K. K. 1998. Unit Operations of Agricultural Processing by Kalya Publishers, Ludhiana.

^{2.} Lloyd, A. & Penizer, R. 2006. Handling, Transportation and storage of Fruits and Vegetables, AVI Publications, UK.

^{3.} Mcabe W. L. and Smith J. C. 2005. Unit operations of chemical engineering. Mc Graw Hill Publication.

^{4.} Gean Koplis C. J. (3rd Edition). Transport processes in unit operations. Prentice Hall of India.

^{5.} P.Fellows. 2000. Food processing technology. Principles and practice. Ellis Horwood England and V C H publishers Germany

^{6.} Earl, P. 1994. Unit operation in Food Processing, Elsevier Science UK.

BE-557 MILK AND MILK PRODUCTS TECHNOLOGY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | None | 3 | 1 | 0 | 4 |

Objective: To impart knowledge of principles of processing of milk and milk products.

| UNIT I | Introduction The milk: definition by PFA, nutritional importance and status of milk production and processing. Milk constituents: their roles and nutritional significance. Properties of milk: chemical and physical. Microorganisms in milk and their roles. | 8 |
|----------|--|---|
| UNIT II | Types of Market MilkQuality testes of milk: platform tests (sensory test, COB test, sedimentation test), alcohol alizarin, resazurine, MBR test, acidity, protein, fat, etc. Handling of milk: milk cleaning, chilling and transportation. | 8 |
| UNIT III | Technology Full cream, standardized milk, toned, double toned milks and their production methods. Processing of fluid milk: pasteurization, sterilization, separation and homogenization. | 8 |
| UNIT IV | Packaging and SanitationTechnology of milk products: cream, butter, cheese, khova, whey, yoghurt, ice-cream, condensed and dried milk | 8 |
| UNIT V | Packaging of fluid milk and dairy products: glass bottles, flexible pouches, aseptic packaging system. Cleaning and sanitization of dairy plant equipments/machineries: types of dairy detergents, methods and procedure of cleaning, basic principle of CIP cleaning. | 8 |

References

Books The Technology of Milk Processing- CP Anantakrishnan and AQ Khan and PN Padmanabhan, Shri Lakshmi Publications, Madras

2. Milk Products Preparation and Control- CP Anantakrishnan and AQ Khan and PN Padmanabhan, Shri Lakshmi Publications, Madras

3. Outline of Dairy Technology- Sukumar De, Oxford University Press

4. Dairy Plant Engineering and Management- Tufail Ahmad, Kitab Mahal, Allahabad

BE-558 POST HARVEST TECHNOLOGY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | None | 2 | 1 | 0 | 3 |

Objective: To acquaint with postharvest physiology of fruit and vegetables and to impart knowledge of processing of fruit and vegetables.

| UNIT I | Introduction | 8 |
|----------|---|---|
| | Status of production and processing of fruits and vegetables in India. | |
| | Challenges before fruit and vegetable processing industry in India and | |
| | government promotional policies. Postharvest losses in fruits and vegetables | |
| | and their reasons. | |
| UNIT II | Composition and Nutritional Importance | 8 |
| | Chemical composition and nutritional values of fruits and vegetables. Postharvest physiology of fruits and vegetables: biochemistry of respiration, respiratory responses of climacteric and nonclimacteric fruits. Physiological developments during maturation: Chemical and nutritional changes | |
| UNIT III | Physiological Disorders | 8 |
| | Chilling injury, its mechanism and preventive measures, mineral deficiency related disorders and their preventions. | |
| UNIT IV | Processing Techniques | 8 |
| | Thermal processing: canning and bottling, drying/dehydration, concentration/ | |
| | evaporation. Freezing, methods and equipment. Fermented and unfermented | |
| | fruit beverages. Quality evaluation of fruit and vegetable products. By - product | |
| | utilization, economic considerations in fruit and vegetable processing. | |

References

Books

1. Post Harvest- Wills, Mc Glasson, Graham, Lee and Hall, CBS Publishers and Distributors, New Delhi

2. Postharvest Physiology of Perishable Plant products- Stainley J Kays, CBS Publishers and Distributors, New Delhi.

3. Fruit & Vegetable Preservation- R.P. Srivastava and S. Kumar, International Book Distributing Co., Lucknow.

4. Preservation of Fruits and Vegetables- Lal, Siddappaa and Tandon, Publications and Information Division, ICAR, New Delhi

BE-559 ENGINEERING PROPERTIES & FOOD STORAGE TECHNOLOGY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | None | 2 | 1 | 0 | 3 |

Objective: To acquaint with properties of bio materials helpful in designing of machines and equipment. To impart knowledge which would be useful to the students after they complete the program and go to practical field. To acquaint with design aspects of food crop storage structures/systems.

| UNIT I | Physical Properties and Thermal Properties | 8 |
|----------|--|---|
| | Importance of the engineering properties of the biological materials, physical properties of food materials, viz. shape, size, specific gravity, porosity, and their methods of determinations. Thermal properties: viz. specific heat, thermal conductivity and thermal diffusivity and their determinations, Dielectric properties of foods, Optical Properties. | |
| UNIT II | Aerodynamic Properties | 8 |
| | Aerodynamic and Hydrodynamic and Frictional, properties, Drag coefficient, terminal velocity, Relation between Drag coefficient and Reynolds number, terminal velocity from time distance relation, Application to agricultural products, Frictional properties, rolling resistance, angle of repose, definition and method of determination. | |
| UNIT III | Rheological Properties | 8 |
| | Rheological properties: concept of Rheology and ASTM definitions of terms related to mechanical properties, Force-deformation curve of the agricultural products, Classical ideal materials, basic rheological models and their interpretation, rheological properties of solid and liquid food, rheological equations. | |
| UNIT IV | Storage | 8 |
| | Rural storage structures for grains. Design considerations of bulk storage structures - grain pressure theories, air distribution systems and aeration fans. Design considerations of bag storage structures. | |

References

^{1.} Food Processing: Biological Appl.- Marwara S.,

^{2.} Engineering Properties of Foods- Rao and Rizwi, CRC Press, Taylor & Francis Group

^{3.} Physical Properties of Plant and Animal Materials- Mohsenin N.N., Gordon and Breach

^{4.} Unit Operations of Agricultural Processing- KM Sahay and KK Singh, Vikas Publishing House Pvt. Ltd., New Delhi.

^{5.} Drying and Storage of Grains and Oilseeds- Brooker, Bakker-Arkema and Hall, AVI Publication

BE-564 FERMENTATION TECHNOLOGY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | None | 2 | 1 | 0 | 3 |

Objective: This paper provides the knowledge of basic principle of fermentation process, which help students to design, develop and operate industrial level fermentation process.

| UNIT I | Introduction to fermentation | 8 |
|----------|--|---|
| | Primary and secondary metabolite. Raw material availability, quality | |
| | processes and pre-treatment of raw materials. | |
| | | |
| UNIT II | Design of fermenter | 8 |
| | Aerobic and anaerobic fermentation. Biomass, Substrate and product kinetics in kinetics in Batch, Fed batch Continuous mode of reaction. | |
| UNIT III | Fermentation products I | 8 |
| | Fermentative Production of Beer, Wines, Cider and Vinegar. Fermented Vegetables (Pickles, Saurkarnt). | |
| UNIT IV | Fermentation products II | 8 |
| 1 | | - |
| | Production of Baker's Yeast, Cereal based fermented food: Idli, Dosa, | |
| | Production of Baker's Yeast, Cereal based fermented food: Idli, Dosa, Dhokla, Soy sauce, Tofu, Tempeh, Natto. | |

References

- 1. K.H. Steinkrus Handbook of Indigenous Fermented Foods
- 2. Sukumar De Outlines of Dairy Technology
- 3. Prescott & Dunn Industrial Microbiology
- 4. L.E. Casida Industrial Microbiology
- 5. W.C. Frazier and D.C. Westhoff Food Microbiology

BE-562 FOOD BIOTECHNOLOGY

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|--------------|---|---|---|---|
| None | None | 2 | 1 | 0 | 3 |

Objective: As a Food Technologist, it is necessary to know that the new varieties of foods and crops are developed. It is also necessary to know how to develop hybrid and GM food as well as the patenting issues related to the use of technology.

| UNIT I | Introduction to Food Biotechnology | |
|----------|---|---|
| | Signification of DNA and RNA in GMO/GMC, Role of microorganism in food | 8 |
| | biotechnology | |
| UNIT II | Concept of genetic engineering | |
| | Basic concept of gene expression and gene complexity in prokaryotes and | 8 |
| | eukaryotes, Enzymes involved in rDNA technology | |
| UNIT III | Molecular methods and Production | |
| | Cloning vectors for production of GMO/GMC, production of genetically modified | 8 |
| | organisms and crops using vectors (eg: Bt. Cotton, Bt. Brinjal etc.) | |
| | Developmental technique for new plant varieties. | |
| UNIT IV | Applications of GMO/GMC and IPR | |
| | Applications of GMO/GMC in food, agriculture and industrial sector, Regulatory | 8 |
| | and Social aspects of Food Biotechnology. Basic concept of IPR (patent with | |
| | patenting step, copy right, trademarks, GI and PBR), Indian patent Act and PCT, | |
| | TRIP, Infringement, GEAC, RCGM | |

References

- 1. Principles of gene manipulation-Old and Primrose
- 2. Molecular Cloning (Vol 1,2,3)-Sambrook and Russell
- 3. Food Biotechnology: Dietrich Knorr, Inc. New York and Basel
- 4. Perry Johnson-Green. Introduction to Food Biotechnology. CRC Press.
- 5. Genetic Engineering by Neelam Pathak and Smita Rastogi.
- 6. Molecular Biology of the gene IV edition by Watson, Hopkin, Roberts et.al
- 7. Biotechnology by B. D. Singh.

BE-563 INTRODUCTION TO BIOINFORMATICS

| Pre-requisite | Co-requisite | L | Т | Р | C |
|---------------|--------------|---|---|---|---|
| None | None | 2 | 1 | 0 | 3 |

Objective: The first aim of bioinformatics is to store the biological data organized in form of a database. The second aim is to develop tools and resources that aid in the analysis of data.

| UNIT I | Introduction | 8 |
|----------|--|---|
| | Definition of Bioinformatics, Biological databases: Nucleotide databases (e.g., GenBank, EMBL, and DDBJ), Biological search engines (e.g., Entrez, SRS, and ARSA). | |
| UNIT II | Biological databases | 8 |
| | Protein databases- Primary protein databases (e.g., SwissProt, Tr-EMBL, and PIR). | |
| UNIT III | Secondary protein databases | 8 |
| | Secondary protein databases (e.g., PROSITE, PRINTS, IDENTIFY, BLOCK, and PFAM), Composite database (e.g., OWL, and NRDB). | |
| UNIT IV | Literature databases | 8 |
| | Literature databases: (e.g., PubMed and PubChem), Biological file formats (e.g., GenPept/GenBank, FASTA, and EMBL), Applications of Bioinformatics. | |

References

1. D. W. Mount: Bioinformatics-sequence and genome analysis, Cold Spring Harbor lab Press.

2. Jin Xiong: Essential Bioinformatics, Cambridge University press.

BE – 560 FOOD PROCESSING LAB

| Pre-requisite | Co-requisite | L | Т | Р | С |
|---------------|-----------------------|---|---|---|---|
| None | BE-557, BE-558, BE559 | 0 | 0 | 6 | 3 |

1. Estimation of saponification value of fats and oils

3. Estimation of iodine value of fats and oils

4. Determine the fat by garbar method and SNF content in the milk

- 5. Perform Alkali Test of milk.
- 6. Determine pH content of milk.
- 7. Determination of apparent density and sphericity of a given food sample
- 8. Determination of surface area of a leaf.
- 9. To study the drying characteristics of a given food sample in a dryer.
- 10. Preparation of jam
- 11. Preparation of jelly
- 12. Preparation of pickles

13. Preparation of tomato products

References

Books

1. The Technology of Milk Processing- CP Anantakrishnan and AQ Khan and PN Padmanabhan, Shri Lakshmi Publications, Madras

2. Food Processing: Biological Appl.- Marwara S.,

3 Engineering Properties of Foods- Rao and Rizwi, CRC Press, Taylor & Francis Group

4. Post Harvest- Wills, Mc Glasson, Graham, Lee and Hall, CBS Publishers and Distributors, New Delhi