आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

**SCHOOL OF BIOTECHNOLOGY**
**IFTM UNIVERSITY**
**www.iftmuniveristy.ac.in**

# Study & Evaluation Scheme of
# Master of Science (Food Technology)
# Session 2021-2022

| | |
|---|---|
| Programme: | Master of Science (Food Technology) |
| Course Level: | PG Degree |
| Duration: | Two Years (four semesters) Full Time |
| Medium of Instruction: | English |
| Maximum required attendance: | 75% |
| Maximum Credits: | 93 |

## Programme Outcomes (POs)

Students completing this programme will be able to:

- Become a highly skilled professional in food technology, equipped with the theoretical, technical and managerial knowledge to contribute to solving problems related to food industry.
- The program particularly focuses on key requirement of food industry like production, processing, preservation, packaging, labeling, quality management, and distribution of food products.
- Utilize technical skill to transform raw materials into food product.
- Explore in different domains such as food processing, soft drink manufacturing; spice, cereal and rice mills; food packaging and pharmaceutical industry etc.
- Gain position as research scientist' position and will able to design research projects/experiments to improve the yield, flavor, nutrition quality and general acceptability of the packaged food.
- Established start-up, and entrepreneurship venture such as consultancy and training centers.

**COURSE STRUCTURE**
**M.Sc. (BIOTECHNOLOGY/MICROBIOLOGY/FOOD TECHNOLOGY)**
**(Effective from 2021-22)**
**First Semester**

| S.N. | Module Code | Module Name | Periods | | | EVALUATION SCHEME | | | | Course Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Mid Sem Exam | AS +AT | Total | End Sem Exam | | |
| **THEORY** | | | | | | | | | | | |
| 1. | MSB-101 | Cell Biology | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 2. | MSB-102 | Biochemistry | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 3. | MSB-103 | Microbiology | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 4. | MSB-104 | Bioinstrumentation | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 5. | MSB-105 | Molecular Biology | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| **PRACTICALS / PROJECT** | | | | | | | | | | | |
| 6 | MSB-151 | Cell Biology & Biochemistry | 0 | 0 | 4 | 20 | 10 | 30 | 70 | 100 | 2 |
| 7 | MSB-152 | Microbiology & Bioinstrumentation | 0 | 0 | 4 | 20 | 10 | 30 | 70 | 100 | 2 |
| | | **Total Credit** | **15** | **5** | 8 | | | **210** | **490** | **700** | **24** |

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**
**(Effective from 2021-22)**

## MSB-101: CELL BIOLOGY

**Objective(s):** The objectives of this course:

- Will build on the knowledge of cell structure and function gained in the undergraduate course's students knowledge of how eukaryotic cells work at the molecular level.
- Provide an overview of cell structure and function at the molecular level, including the flow of information from genes to proteins, and regulation of cellular processes, signaling and proliferation in eukaryotic cells.
- Introduce some of the major ideas and experimental approaches in cell and molecular biology.

**UNIT I:** **(8 Sessions)**

**Cell Basics:** Discovery of cell; The Cell theory; Ultrastructure and functions of prokaryotic and eukaryotic cells. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Nucleus, with nuclear pore complex, Nucleolus, Endoplasmic reticulum, Golgi complex, Ribosome; Biogenesis of mitochondria and chloroplast.

**UNIT II:** **(8 Sessions)**

**Cytoskeleton, Cell Motility and Cellular Interaction:** Microtubules, microfilaments and intermediate elements; Cell motility - Amoeboid, ciliary and flagellar movements. Microvilli, Tight Junction, Desmosome; Connexon; Intercellular communication and Gap Junction.

**UNIT III:** **(8 Sessions)**

**Cell Division and Cell Cycle:** Mitosis -Mitotic Apparatus – centromere/kinetochore; Spindle microtubule; Metaphase chromosomal motion; Anaphase chromosomal movement. Meiosis- Meiotic division I and Meiotic division II; Cytokinesis in animal and plant cells; regulation and control of cell cycle.

**UNIT IV:** **(8 Sessions)**

**Cell signaling**: Extracellular Messengers & their receptors, G-protein- Coupled receptors their second messengers and signal transduction pathway-Specificity of G-protein coupled responses, Regulation of Glucose levels, Role of GPCRs in sensory perceptions. Protein Tyrosine Kinases- Receptor tyrosine kinases (RTKs), Dimerization, Protein Kinase activation, RTKs activates downstream signaling pathway, signaling by the insulin receptors; Calcium as an intracellular messenger: IP3 and Voltage-Gated $Ca^{2+}$ Channels, Calcium binding Protein (calmodulin); light induced signal transduction (Plant transduction).

**UNIT V:** **(8 Sessions)**

**Cancer:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, apoptosis.

**Course Outcomes:**

Upon successful completion of the course, students should be able to:

- Understand and utilize the scientific vocabulary used in communicating information in cell and molecular biology
- Understand and apply general concepts of cell and molecular biology to relevant, specific problems
- Describe and discuss the properties and biological significance of the major classes of molecules found in living organisms and the relationship between molecular structure and biological function

- Represent and illustrate the structural organization of genes and the control of gene expression
- Conceptualize and describe protein structure, folding and sorting
- Explain the structure of membranes and intracellular compartments and relate these to function.
- Summarize the processes of energy transduction in cells and explain their significance.
- Relate how cell movement and cell-cell communication occur and discuss mechanisms of signal transduction
- Outline the processes that control eukaryotic cell cycle and cell death.
- Link the rapid advances in cell and molecular biology to a better understanding of diseases, including cancer.

**Suggested Readings:**


1. Buchanan et al. Biochemistry & Molecular Biology of plants (2004)
2. Nelson & Cox Lehninger Principles of Biochemistry, (2005)
3. Karp,G.. Cell and Molecular Biology; Concepts & Experiments (2004).
4. Cooper,G.M. The Cell: A molecular Approach (2004)
5. deRobertis&dfRobertis. Cell & Molecular biology
6. Hughes &Mehnet. Cell proliferation and apoptosis (2003)
7. Albert's et al Molecular Biology of Cells, (2002), 4th Edition
8. Lodish et al. Molecular Cell Biology (2004)


**Website Sources:**

- https://www.edx.org/learn/cellular-biology
- https://www.coursera.org/courses?query=cell%20biology
- https://bscb.org/learning-resources/softcell-e-learning/
- https://www.mooc-list.com/tags/cell-biology
- https://nptel.ac.in/courses/102/103/102103012/

**IFTM University, Moradabad**

**Master of Science (M.Sc.), Programme**

**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**

**(Effective from 2021-22)**

## MSB-102: BIOCHEMISTRY

**Objective(s):** The objectives of this course:

- Is designed to introduce the students to the study of biological phenomena at the molecular level.
- Aims to make the students understand the fundamental chemical principles that govern complex biological systems.
- Have major focuses on disciplines within biology and chemistry to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis.
- Enable students to acquire a specialized knowledge of the biological molecules and their structure.

**UNIT I:** **(8 Sessions)**

**Carbohydrates:** Composition; basic structure and function of carbohydrates, Mono-, di- ,oligo-saccharides, Glycosidic bonds; glycoproteins (O- linked and N- linked), glycolipids; Polysaccharides- Classification, Homopolysaccharides; Heteropolysaccharides; Metabolism- Glycolysis, TCA cycle, Gluconeogenesis, HMP pathway, Glycogenesis, Glycogenolysis.

**UNIT II:** **(8 Sessions)**

**Proteins:** Primary, Secondary, Tertiary and Quaternary structure of Proteins; Globular protein- Hemoglobin and Myoglobin; Fibrous protein- Collagen and Membrane Protein; ATP synthetase; Protein sequencing; Evolutionary divergence of organisms and its relationship to protein structure and function; Ramachandran plot; Protein folding.

**UNIT III:** **(8 Sessions)**

**Fatty acids:** General formula, nomenclature and chemical properties; Lipid classification- simple, complex; General structure and functions of major lipid subclasses - acyl glycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins & free fatty acids; Fatty acid oxidation (β oxidation of fatty acid); Regulation of fatty acid metabolism; Ketone bodies; Circulating lipids - chylomicrons. LDL, HDL and VLDL.

**UNIT IV:** **(8 Sessions)**

**Fat soluble and water soluble vitamins**: structure and function, Cofactors and coenzymes: structure and function; Coenzymes and their functions - NAD, $NADP^+$, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin; Hormones**:** Classification; site of formation, target organs; Mechanism of action of peptide and steroid hormones: Insulin, Glucagon, Epinephrine, Norepinephrin, Thyroid hormones, Testosterone, Estrogen, Progesterone, Pheromones; Hormonal regulation of metabolism by mineralocorticoids.

**UNIT V:** **(8 Sessions)**

**Nucleic Acids:** Structure of purines, pyrimidines, nucleosides and nucleotides; Physical & biochemical properties of DNA; Types of DNA- A, B and Z DNA, their structure and significance; Physical & biochemical properties of RNA- tRNA, rRNA, mRNA and hnRNA; Primary, secondary, and tertiary structures of RNA; metabolism of Purines and Pyrimidines (*De-novo* and Salvage pathway).

**Course Outcomes:**

Students completing this course will be able to:

- Demonstrate knowledge and understanding of the molecular machinery of living cells.
- Demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.

- Demonstrate knowledge and understanding of the principles of the basic composition of the genetic material that ultimately leads to the formation of complex system.

**Suggested Readings:**


1. D. Papachristodoulou, A. Snape, W. H. Elliott, Daphne C. Elliott. Biochemistry and Molecular Biology, V Ed.,Oxford University Press, 2014.
2. K. Trehan. Biochemistry, II Edition, New Age International, 2007.
3. D.L. Nelson, M. M. Cox. Lehninger Principles of Biochemistry, V Ed., CBS Publication, 2016.
4. D. Voet, C. W. Pratt, J.G. Voet, Principles of Biochemistry: International StudentVersion, IV Ed., Wiley, New York.
5. J.M. Berg, J.L., Tymoczko, L. Stryer. Biochemistry: VII Ed., W.H. Freeman Int. Edition, 2010.


**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**
**(Effective from 2021-22)**

## MSB-103: MICROBIOLOGY

**Objective:** The objective of this course:

- Is to provide knowledge about the microbial world their morphology, difference from other living organisms, distribution and their specific roles in various fields of human life and industry.

**UNIT I:** **(8 Sessions)**

**Introduction to Microbiology:** Definition, Historical background & scope; Prokaryotes and eukaryotes, Difference between prokaryotic and eukaryotic organisms; Method of Microbiology- Pure culture techniques, sterilization techniques, Culture media and its types; microbial nutrition; Microbial growth and kinetics.

**UNIT II:** **(8 Sessions)**

**Bacteria:** General characteristics; Morphology and structure of bacteria; Gram positive and gram negative bacteria; Basic principle and techniques used in bacterial Classification; Types of vegetative, asexual and sexual reproduction in bacteria.

**UNIT III:** **(8 Sessions)**

**Viruses:** General characteristics; Morphology, Classification and structure of plant, animal and bacterial viruses; Cultivation of viruses, a brief account of Adenoviruses, Herpes, Retrovirus, Viroids and prions; Reproductive cycles: lytic and lysogenic.

**UNIT IV:** **(8 Sessions)**

**Control of Microorganism:** Antimicrobial Agents; Sulfa drugs, Antibiotics (penicillin and cephalosporin); Broad Spectrum Antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance of antibiotics.

**UNIT V:** **(8 Sessions)**

**Microbial Ecology:** Microbial flora of soil; Interaction among soil microorganisms; Nitrogen fixation; Symbiotic association-types, functions and establishment of symbiosis; *A. niger*, yeast, *Pseudomonades putida*.

**Course Outcomes:**

At the end of this course:

- The students get trained in all aspects of microbiology as it is required in the field of biotechnology, microbiology and food technology.
- The students can recognize and compare the structure and function of microbes.
- Imparts advanced training in microbiology for the students.

**Suggested Readings:**


1. Pelczar Jr. M.J., Chan E.C.S. and Krieg R., Microbiology, McGraw Hill (1998).
2. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Pamler P.R., General Microbiology, MacMillan (2003).
3. Powar&Dagniwala. Microbiology, Volume 1, Himalaya Publishing House Pvt. Ltd, 2012.
4. Tortora G.J., Funke B.R., and Case C.L., Microbiology, An Introduction, Pearson Education (2009).
5. Madigan, M., Martinko, J., Dunlap, P. and Clark, D., Biology of Microorganisms, Pearson Education (2015).

**Website Sources:**


- https://www.khanacademy.org/
- https://www.britannica.com/
- https://www.wikipedia.org/
- https://www.researchgate.net

**IFTM University, Moradabad**

**Master of Science (M.Sc.), Programme**

**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**

**(Effective from 2021-22)**

## MSB-104: BIOINSTRUMENTATION

**Objective(s):** The objectives of this course:

- Is to provide principle of the various analytical techniques, which will be helpful in various applications in the field of life science like Molecular Genetics, Cell Biology, Genetic Engineering, Environmental Science and other fields.
- The student will learn to technical aspect of functioning of these bio instruments.

**UNIT I: (8 Sessions)**

**Microscopic Techniques:** Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy; Scanning and Transmission Electron Microscopy; Confocal Microscopy; Advances of microscopy.

**UNIT II: (8 Sessions)**

**Chromatography Techniques & Centrifugation Techniques:** Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC; Density & Ultra Centrifugation.

**UNIT III: (8 Sessions)**

**Electrophoresis Techniques:** Theory and Application of PAGE, Agarose Gel Electrophoresis, Iso-electric Focusing, Immuno diffusion, Southern, Northern and Western Blotting.

**UNIT IV: (8 Sessions)**

**Spectroscopic Techniques:** Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, NMR, Atomic Absorption Spectroscopy, Raman Spectroscopy

**UNIT V: (8 Sessions)**

**Radio-isotopic Techniques:** Introduction to Radioisotopes and their Biological Applications; Radioactive Decay – Types and Measurement; Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter; Autoradiography, Radiation Dosimetry.

**Course Outcomes:**

Students completing this course will be able to:

- Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis.
- Discuss the terms, principle, instrumentation, operation and applications of Molecular spectroscopic techniques.
- Differentiate between principle, instrumentation and operation of Atomic absorption and emission Spectroscopy.
- Explain the various Separation techniques and its instrumentation.

**Suggested Readings:**


1. Skoog & West Principle of Instrumental Analysis 4th Edn 1992.
2. Freilder. Physical Biochemistry: Application to Biochemistry and Molecular Biology, 2nd Edn 1983.
3. Keith Wilson & John Walker Principles and Techniques of Biochemistry and Molecular Biology:, 7th Edn., Cambridge University Press.
4. S. K. Sawhney & Randhir Singh., Introductory Practical Biochemistry 5th Edn, 2014.
5. G. R. Chatwal & S. K. Anand, Instrumental Methods of Chemical Analysis, Oscar publication, 2015.

**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**
**(Effective from 2021-22)**

# MSB-105: MOLECULAR BIOLOGY

**Objective(s):** The objectives of this course:

- Is to provide core principles of molecular biology and to impart knowledge to students about the importance of molecular genetics.
- Will help learners to understand the organization and structure of DNA and its properties.
- Will let the student have an in-depth knowledge on molecular mechanisms like Replication, Transcription, Translation, regulation of genetic expression and cancer biology.

**UNIT I:** **(8 Sessions)**

**Nuclear organization:** Nuclear membrane, chromosome structure. Proteins associated with nuclei. nucleosome model. Nuclear DNA content, C-Value paradox, Cot value and its significance in situ hybridization, Structural alteration in chromosome: Deletion, Duplication, Inversion & Translocation, heterozygote. Special types of chromosomes; Salivary gland and Lamp-brush chromosomes. Gene mutation: Types of mutations, Molecular mechanism of mutations. Polyploidy (aneuploids, autopolyploids and allopolyploids).

**UNIT II:** **(8 Sessions)**

**DNA Replication:** Mechanism of DNA replication (Prokaryotic and Eukaryotic), Enzymes involved in DNA replication (Helicases, DNA polymerase, Topoisomerase etc). Type of DNA repair. Regulation of telomere length. DNA recombination; site specific recombination.

**UNIT III**: **(8 Sessions)**

**Transcription:** Structure of bacterial RNA polymerase, Transcription events, and sigma factor cycle, Eukaryotic RNA polymerase, Promoter sequences, TATA box, Hogness Box, CAAT box, Enhancers, upstream activating sequences, Initiation and termination of transcription factor, RNA processing in Prokaryotes *Vs* Eukaryotes.

**UNIT IV**: **(8 Sessions)**

**Translation:** Prokaryotic and Eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. Post-translational modifications and intracellular proteins transport. Control of gene expression in prokaryotes and eukaryotes, operon model- lac and trp operon, Autogenous regulation, Feedback inhibition, Lytic cascades and lysogenic repression.

**UNIT V:** **(8 Sessions)**

**Genetic disease and diagnostics:** Sex linked and autosomal diseases. Molecular Biology of Cancer- causes and genetics of cancer, Tumor suppressor genes and onco genes, anticancer agent (p53 and pRB). Tools in molecular biology- Fluorescent In-situ Hybridisation (FISH), DNA microarrays, Advantages and disadvantages of DNA microarrays.

**Course Outcomes:**

By the end of this course, students will be able to:

- Describe the nuclear organization of DNA and various models of nuclear organization
- Describe types of mutations and various levels of ploidy
- Explain the different types of molecular mechanisms like Replication, Transcription and translation
- Explain the role of p53 and pRB in the development of cancer and molecular tools like FISH and microarrays.

**Suggested Readings:**


1. Miglani G.S. Advance Genetics by Narosa Publishing House.
2. S.B. Primrose, R.Twyman. Principles of Gene Manipulation and Genomics, VII Ed., Wiley-Blackwell, 2006.
3. D.L. Nelson, M.M. Cox. LehningerPrinciples of Biochemistry, . V Ed., 2016.
4. J.D. Watson. A Passion for DNA: Genes, Genome &Society, Cold Spring Harbor Laboratory Press, 2000
5. Albert's et al. Molecular Biology of Cells, IVth Edition, 2002.
6. Lewin B. , Genes VII, 7th edition, Oxford University Press; 2000


**Website Sources:**

- https://ocw.mit.edu/courses/health-sciences-and-technology/
- https://thebiologynotes.com/microbial-genetics/
- https://www.sparknotes.com/biology/
- https://www.cliffsnotes.com/study-guides/biology/biochemistry-i/
- biological-information-flow/the-central-dogma-of-molecular-biology

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**
**(Effective from 2021-22)**

## MSB-151: Cell Biology and Biochemistry

| | | |
|---|---|---|
| **1.** | Introduction of Laboratory Practices | |
| **2.** | Safety Measures | |
| **3.** | Do and Don't | |
| **4.** | About Equipment and Accessories and Working | |
| **5.** | To study of the properties of carbohydrates.<br>Experiment: I A Molish Test<br>Experiment: 1 B. Benedict's Test; | Experiment 1 |
| **6.** | 2A: To estimate given amount of protein by Folin-Lowry method.<br>2B: To estimate the protein content in the given sample by Biurret methods. | Experiment 2 |
| **7.** | 3A: Qualitative test for the presence of fatty acid by titrametric methods.<br>3B: Estimation of cholesterol by Liebermann-Buchard reaction. | Experiment 3 |
| **8.** | To learn technique SDS-PAGE and to separate protein according to their molecular size. | Experiment 4 |
| **9.** | To understand the process and different stages of mitosis. | Experiment 5 |
| **10.** | To determine the concentration of cells in a given sample using hemocytometer. | Experiment 6 |
| **11.** | To detect the presence of amino acid from a given sample by Ninhydrin Test or Xanthoproteic acid Test. | Experiment 7 |
| **12.** | To stain lignin of the plant section and observe under the microscope. | Experiment 8 |

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)**
**(Effective from 2021-22)**

## MSB-152: Bioinstrumentation and Microbiology

| | | |
|---|---|---|
| **1.** | Introduction of Laboratory Practices | |
| **2.** | Safety Measures | |
| **3.** | Do and Don't | |
| **4.** | About Equipment and Accessories and Working | |
| **5.** | Working Principle and structural components of simple microscope. | Experiment 1 |
| **6.** | Working Principle and structural components of compound microscope. | Experiment 2 |
| **7.** | Basics Working and Principle of Autoclave | Experiment 3 |
| **8.** | Basics Working and Principle of Biological Safety Cabinet (Laminar Air Flow Chamber) | Experiment 4 |
| **9.** | Study of Sterilization methods and equipments. | Experiment 5 |
| **10.** | To prepare and sterilize the nutrient broth media. | Experiment 6 |
| **11.** | To prepare and sterilize the nutrient agar media (NAM) and to prepare nutrient agar slants. | Experiment 7 |
| **12.** | To isolate and enumerate microorganisms from soil sample by spread and streak plate methods. | Experiment 8 |
| **13.** | To isolate and enumerate microorganisms from soil sample by serial dilution method. | Experiment 9 |
| **14.** | To isolate the microorganisms from mixed culture by sub-culturing technique. | Experiment 10 |
| **15.** | To stain bacterial cell by simple staining method. | Experiment 11 |

**IFTM UNIVERSITY, MORADABAD**
**COURSE STRUCTURE**
**M.Sc. (FOOD TECHNOLOGY)**
**Second Semester**

| S.N. | Module Code | Module Name | Periods | | | EVALUATION SCHEME | | | End Sem Exam | Course Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Mid Sem Exam | AS +AT | Total | | | |
| **THEORY** | | | | | | | | | | | |
| 1. | MSB-201 | Enzymology & Enzyme Technology | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 2. | MFT-201 | Food Microbiology | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 3. | MFT-202 | Principle of Food Processing | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 4. | MFT-203 | Food and Nutritional Chemistry | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 5. | MFT-204 | Food Fermentation | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| **PRACTICALS / PROJECT** | | | | | | | | | | | |
| 7. | MFT-251 | Food Microbiology | 0 | 0 | 4 | 20 | 10 | 30 | 70 | 100 | 2 |
| 8. | MFT-252 | Food Fermentation | 0 | 0 | 4 | 20 | 10 | 30 | 70 | 100 | 2 |
| | | Total Credit | 15 | 5 | 8 | | | 210 | 490 | 700 | 24 |

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. (Biotechnology/Food Technology) I Year (II Semester)**
**(Effective from 2021-22)**

## MSB -201: ENZYMOLOGY & ENZYME TECHNOLOGY

**Objective(s):** The objectives of the course:

- Provide a deeper insight into the fundamentals of enzyme structure, function and kinetics of enzymes and techniques employed in enzymes purification and characterizations are also emphasized in this course.
- Will introduce students to the theory as well as applications of enzyme technology in various industries.
- Serves to provide an awareness of the current and possible future applications of enzyme technologies.

**UNIT I:** **(8 Sessions)**

**Introduction to Enzymes:** Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate – lock and key model, induced fit model; Features of active site, activation energy, enzyme specificity and types.IUB system of classification and nomenclature of enzymes. Isolation and purification of enzymes from plants, animals and microbes; Enzyme activity; Unit of enzyme activity- definition and importance.

**UNIT II:** **(8 Sessions)**

**Enzyme Kinetics:** Kinetics of single substrate reactions; Derivation of Michaelis-Menten equation, turnover number; Determination of Km and Vmax (LB plot, ED plot), Importance of Km & Vmax; Multi-Substrate reaction mechanisms. Deactivation Kinetics. Specific activity.

**UNIT III:** **(8 Sessions)**

**Factor Affecting Enzyme Activity, Catalysis and Regulation:** Factors affecting the velocity of enzyme catalyzed reaction: enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators, Acid-base and nucleophilic catalysis, Role of metal ions in enzyme catalysis; Enzyme Inhibition: irreversible; reversible (competitive, uncompetitive and non-competitive inhibition); Allosteric regulation of enzymes, concerted and sequential model.

**UNIT IV:** **(8 Sessions)**

**Structure and Function of Enzymes:** Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases; Lipases, papain, ribonuclease, trypsin, carboxypeptidase, phosphorylase; Multi enzyme complexes- pyruvate dehydrogenase and fatty acid synthetase.

**UNIT V:** **(8 Sessions)**

**Enzyme Immobilization, Reactors and Biosensors:** Adsorption, Matrix entrapment, Cross linking, Encapsulation, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques; Enzyme Reactors – Stirred tank reactors (STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed-bed reactors (PBR), Fluidized-bed Reactor (FBR); Membrane reactors. Biosensors – glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors.

**Course Outcomes:**

Students will be able to:

- State the enzyme kinetics, various factors regulating catalysis, different models for analyzing the enzyme kinetics, Immobilization and large-scale production of enzyme.
- Apply biochemical calculation for enzyme kinetics. Plot graphs based on kinetics data

- Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

**Suggested Readings:**


1. Alan Fersht: Structure and Mechanism in Protein Science, 2nd ed. W.H. Freeman & Co.
2. Nicolas Price & Lewis Stevens: Fundamentals of Enymology, 2nd edition, Oxford Univ. Press, New York, NY.
3. Trevor Palmer: Understanding Enzymes, Second Edition, J. Wiley & Sons, New York.
4. Donald Voet& Judith Voet: Biochemistry, J. Wiley & Sons, New York
5. Geoffrey Zubay (1993): Biochemistry, 3rd edition, Wm. C. Brown, Oxford
6. Berg, Tymoczo and Stryer: Biochemistry, 7th Edition., W.H.Freeman,2010
7. Nicolas Price & Lewis Stevens: Fundamentals of Enymology, 2nd edition, Oxford Univ. Press, New York, NY.


**Website Sources:**

- https://www.omicsonline.org/scholarly/enzyme-technology-journals-articles-ppts-list.php
- https://www.britannica.com/science/enzyme
- https://www.sciencedirect.com/book/9780444641144/advances-in-enzyme-technology
- http://www.biologydiscussion.com/enzymes/enzyme-technology/enzyme-technology-application-and-commercial-production-of-enzymes/10185
- http://www.biologymad.com/studentswork/12%20-%20etnotes.pdf
- https://www.kth.se/dib/enzyme-technology-1.783173
- http://www1.lsbu.ac.uk/water/enztech/whither.html
- https://bmcbiotechnol.biomedcentral.com/articles/sections/protein-and-enzyme-technology
- http://www.odofin.com/enzyme%20technology.htm
- https://www.thesciencenotes.com/enzyme-technology/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology I Year (II Semester)**
**(Effective from 2021-22)**

## MFT-201: FOOD MICROBIOLOGY

**Objective(s):** The objectives of the course:

- To provide instruction in the general principles of food microbiology.
- It is assumed that students will have received adequate introduction to microbiology.
- The course covers the biology and epidemiology of food borne microorganisms of public health significance, including bacteria, yeasts, fungi, protozoa and viruses, and food spoilage microorganisms; the microbiology of food preservation and food commodities; fermented and microbial foods.
- Principles and methods for the microbiological examination of foods; micro biological quality control, and quality schemes.

**UNIT I:** **(8 Sessions)**

**History of Microorganisms in food**: Historical Developments and scope of food microbiology; Classification and identification of yeasts, molds and groups of bacteria important in food industry; Intrinsic and extrinsic parameters of foods that affect microbial growth.

**UNIT II:** **(8 Sessions)**

**Microorganisms in food:** Role and significance of microorganisms in food-Fresh meat and poultry, processed meat, seafoods, fruits and vegetable products, cereals products, dairy food products, fermented food products; starter cultures; production process of SCP, cheese, beer, wine and distilled spirits.

**UNIT III:** **(8 Sessions)**

**Food hygiene and sanitation**: Importance and principles of food hygiene and sanitation; Contamination during handling and processing and its control; indicator organisms; Rapid methods in detection of microorganisms; Microbiological Examination of surfaces, air sampling.

**UNIT IV:** **(8 Sessions)**

**Food preservation:** Methods and principles of food preservation- Physical: Low temperature; High temperature (pasteurization, canning); Irradiation (UV, microwave, ionization); Drying; High pressure processing; Chemical preservatives and natural antimicrobial compounds; Biobased preservation systems- LAB and bacteriocins.

**UNIT V:** **(8 Sessions)**

**Food Born Diseases:** Diseases (Botulism, Cholera, Gastroenteritis, Hepatitis, Poliomyelitis, Amoebiasis), their causative agents, symptoms and preventions; Mycotoxins in food with reference to Aspergillus species.

**Course Outcomes:**

Students completing this course will be able to:

- Explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival.
- Explain the significance and activities of microorganisms in food.
- Describe the characteristics of food borne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification.
- Explain why microbiological quality control programmes are necessary in food production.
- Explain the effects of fermentation in food production and how it influences the microbiological quality and status of the food product.
- Discuss the microbiology of different types of food commodities

- Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food

**Suggested Readings:**


1. Frazier, W.S. and Weshoff, D.C.. Food Microbiology, 4th Ed., McGraw Hill Book Co., New York, 1988.
2. Mann &Trusswell. Essentials of human nutrition. 3rd edition .oxford university press, 2007.
3. Lindsay. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier, 1988.
4. Roger, A., Gordon, B. and John, TFood Biotechnology, 1989.
5. Jay, J.M., Modern Food Microbiology, CBS Publications, New Delhi,1987.


**Website Sources:**

- http://www.fda.gov/Food/ScienceResearch/ResearchAreas/SafePracticesforFoodProcesses/default.htm
- Codex – Food hygiene www.fao.org/docrep/W4982E/w4982e09.html
- www.europa.eu.int/comm/dg24/health/sc/scv/out26_en.html
- CAC – Principles www.who.int/fsf/mbriskassess/pdf/draftpr.pdf
- International commission on Microbiological Specifications for Foods (ICMSF) www.ICMSF.org
- Ozfoodnet.org.au www.cdc.gov/foodnet
- Food Standards Australia New Zealand www.foodstandards.gov.au

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology I Year (II Semester)**
**(Effective from 2021-22)**

## MFT-202: PRINCIPLES OF FOOD PROCESSING

**Objective(s):** The objectives of this course:

- Enables the students to understand the basic principles of food processing used to achieve preservation and to learn about the principles of equipment for processing of food with heat addition or removal.
- List and define the unit operations and understand how they are used in the processing of foods.

**UNIT I:** **(8 Sessions)**

I**ntroduction**: Definition and scope of food Science and Technology; historical development of food processing and preservation; Effect of processing on sensory characteristics of foods- color, texture, and taste; Effect of processing on nutritional properties.

**UNIT II:** **(8 Sessions)**

**Processing and preservation by heat:** Blanching, Pasteurization, Heat sterilization, UHT processing, Evaporation and distillation, Extrusion, dielectric heating, Drying and Dehydration, microwave heating, baking and roasting.

**UNIT III:** **(8 Sessions)**

**Processing and preservation by low temperature:** Chilling, freezing, freeze drying and freeze concentration, Controlled and Modified atmosphere storage.

**UNIT IV:** **(6 Sessions)**

**Processing and preservation by non-thermal methods:** Principles and applications in foods- Irradiation, Hurdle technology, high pressure processing, pulsed electric field, Membrane technology, Nanotechnology.

**UNIT V:** **(10 Sessions)**

**Food Process Economics:** Various stages in plant design, financial analysis, Cost of Production, Break Even Analysis, Project Economics: Fixed Capital, Working Capital, Growth Capital. Depreciation, General Process Economics for clarified Fruit Juices.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the different processing and preservation methods.
- Be able to use the mass and energy balances for a given food process.
- Understand the source and variability of raw food material and their impact on food processing operations.

**Suggested Readings:**


1. D. G. Rao. Fundamentals of Food Engineering.PHI Learning Pvt. Ltd., 2010.
2. B Sivasankar. Food Processing and Preservation. PHI Learning Private Limited (2013).
3. D.R. Heldman and R.W. Hartel, Principles of Food Processing; Aspen Publication, 2nd ed., 1999.
4. P.J. Fellows; Food Processing Technology: Principles and Practice Wood head publishing; 3rd ed. 2009.
5. Stephanie Clark, Stephanie Jung, Buddhi Lamsal, Food processing: Principles and Application, 2014.

**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/
- ecoursesonline.iasri.res.in

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology I Year (II Semester)**
**(Effective from 2021-22)**

## MFT-203: FOOD AND NUTRITIONAL CHEMISTRY

**Objective(s):** The objectives of this course:

- Provides knowledge about the analytical, biochemical, chemical, physical, nutritional, and toxicological aspects of food and food ingredients.
- This will enable students to understand the properties and role of various constituents in foods, interaction and changes during processing.

**UNIT I:** **(8 Sessions)**

**Food chemistry Water and carbohydrates**: Definition and importance, Major food constituents and their physico-chemical properties; Carbohydrates- Structure, Classification, chemical reactions, functional properties of sugars and polysaccharides in foods; Effect of processing on nutritional quality of carbohydrates; Water in foods- Types of water in foods, Water activity-Definition, measurement of water activity, role and importance of water activity in foods.

**UNIT II:** **(10 Sessions)**

**Proteins and lipids:** Definition and importance, classification, structure, sources, functions, physico-chemical properties and functional properties of proteins; Browning reactions in foods; Protein concentrates, isolates and hydrolysates and their applications. Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties, auto-oxidation and rancidity of lipids.

**UNIT III:** **(6 Sessions)**

**Vitamins and Minerals:** Classification, properties, Effect of processing on vitamins and minerals, antioxidants, deficiency and diseases; Enrichment and fortification.

**UNIT IV:** **(8 Sessions)**

**Enzymes, Flavors and pigments:** Chemistry, classification, mode of action, specificity, enzymatic browning and their control, Applications of enzymes in food industry. Natural food flavors, extraction methods and characterization; Pigments in food and their industrial applications.

**UNIT V:** **(8 Sessions)**

**Metabolic rate and caloric needs:** Requirements and role of nutrients in human health, RDAs. Nutrition of dietary fibers; Biological value of proteins; Energy value of foods; Techniques of diet and health surveys; Formulation of diets and food products for specific needs.

**Course Outcomes:**

Students completing this course will be able to:

- Relate the chemical composition of foods to their functional properties.
- Give a molecular rationalization for the observed physical properties and reactivity of major food components.
- Learn information about various food constituents, and changes that occur in them during food processing.

**Suggested Readings:**

1. Aurand, L.W. and Woods, A.E. Food Chemistry. AVI, Westport, 1973.

2. Birch, G.G., Cameron, A.G. and Spencer, M. Food Science, 3rd Ed. Pergamon Press, New York, 1986.
3. Fennema, O.R. Ed. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York. 1976.
4. Meyer, L.H. Food Chemistry. East-West Press Pvt. Ltd., New Delhi. 1973.
5. Potter, N.N. Food Science. 3rd Ed. AVI, Westport. 1978.

**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- http://ecoursesonline.iasri.res.in/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology I Year (II Semester)**
**(Effective from 2021-22)**

## MFT-204: FOOD FERMENTATION

**Objective(s):** The objectives of this course:

- Is to introduce the learners with food processing technology that utilizes the growth and metabolic activity of microorganisms for the stabilization and transformation of food materials.
- Designed so that a food technology student can get knowledge about several fermented food and food related products and can discusses the technologies of some popular traditional foods of fermentation origin.
- Discusses the potential microbiologic risks associated with their consumption and the food safety challenges that they raise.

**UNIT I:** **(8 Sessions)**
**Preparation and Maintenance**: Preparation and Maintenance of Bacterial, Yeast and Mold; cultures for food fermentations; Indian traditional sweet, savory and snack food products: Sweetmeats, Idli and Dosa.

**UNIT II:** **(8 Sessions)**
**Production of organic acid and amino acid**: Organic Acid- Acetic Acid, Lactic Acid, Citric Acid Amino acid- Glutamic acid, Tryptophan Production of Vitamins: VitaminB12.

**UNIT III:** **(8 Sessions)**
**Fermented Animal Products:** Cheeses, Curd and Yoghurt, Butter milk and the fermented milks; Spoilages and defects of fermented dairy products and their control; Fermented meat and fish products.

**UNIT IV:** **(8 Sessions)**
**Fermented Beverages and vegetables:** Fermentative Production of Beer, Wines, Cider and Vinegar. Fermented Vegetables (Pickles)- sauerkraut, olives, kimchi; Oriental fermented foods.

**UNIT V:** **(8 Sessions)**
**Food processing Aids:** Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes,–Food additives- food color, flavor enhancers, emulsifier and food preservatives.

**Course Outcomes:**
Students completing this course will be able to:

- Understand theoretically how to isolate and maintain industrially important strain of any microorganism. Also how to initiate any fermentation process
- Understand basics of production of several industrially important fermented products like wine, cheese and vinegar.

**Suggested Readings:**


1. P.F. Stanbury, A. Whitaker, S.J. Hall, Principles of Fermentation Technology, Third revised ed., Butterworth-Heinemann Ltd, 2016
2. J.E. Bailey, F. David, Biochemical Engineering fundamentals, Second ed., 2010.
3. A.H. Patel, Industrial Microbiology. MacMillan Publishers. 2015.
4. K.H. Steinkrus : Handbook of Indigenous Fermented Foods
5. Samuel Cate Prescott; Cecil Gordon Dunn; Gerald Reed. Prescott & Dunn's industrial microbiology.Publisher:Westport, Conn(1982).
6. L.E. Casida. Industrial Microbiology.1st edition. John Wiley & Sons Inc; (December 1968)

7. William C. Frazier, Dennis C. Westhoff .Food Microbiology.Edition:3, Tata McGraw-Hill Publishing Company.

**Website Sources:**

- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology I Year (II Semester)**
**(Effective from 2021-22)**

**MFT-251: Food Microbiology**

| | | |
|---|---|---|
| **1** | Introduction of Laboratory Practices | |
| **2** | Safety Measures | |
| **3** | Do and Don't | |
| **4** | About Equipment and Accessories and Working | |
| **5** | Preparation of special culture media | Experiment 1 |
| **6** | Assessment of surface sanitation by SWAB RINSE METHOD | Experiment 2 |
| **7** | Assessment of personal hygiene by swab method | Experiment 3 |
| **8** | To study proteolytic bacteria using skim milk agar media | Experiment 4 |
| **9** | To study yeast and mold growth using potato dextrose agar medium (PDA) | Experiment 5 |
| **10** | To study starch hydrolyzing microorganisms using starch agar medium | Experiment 6 |
| **11** | To study the growth of coliform on EMB agar medium | Experiment 7 |
| **12** | To perform mounting of fungi using Lacto phenol cotton blue | Experiment 8 |

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology I Year (II Semester)**
**(Effective from 2021-22)**

## MFT-252: Food Fermentation

| | | |
|---|---|---|
| **1** | Introduction of Laboratory Practices | |
| **2** | Safety Measures | |
| **3** | Do and Don't | |
| **4** | About Equipment and Accessories and Working | |
| **5** | Introduction to Food Fermentation Lab | Experiment 1 |
| **6** | To produce ethanol under submerged conditions using *Saccharomyces cerevisiae* | Experiment 2 |
| **7** | To extract and purify ethanol produced under submerged conditions | Experiment 3 |
| **8** | To study the Baker's yeast production under submerged conditions. | Experiment 4 |
| **9** | To study the production of sauerkraut. | Experiment 5 |
| **10** | To study the production of single cell proteins. | Experiment 6 |
| **11** | To study the production of lactic acid from whey. | Experiment 7 |
| **12** | To study the production of Cheese making from whole milk | Experiment 8 |
| **13** | To study the production Citric acid from whey with sugars and additives by *Aspergillus niger*. | Experiment 9 |

**IFTM UNIVERSITY, MORADABAD**
**COURSE STRUCTURE**
**M.Sc. (FOOD TECHNOLOGY)**
**(Effective from 2021-22)**
**Third Semester**

| S.N. | Module Code | Module Name | Periods | | | EVALUATION SCHEME | | | | Course Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Mid Sem Exam | AS +AT | Total | End Sem Exam | | |
| **THEORY** | | | | | | | | | | | |
| 1. | MFT-301 | Post Harvest Management of Fruits & Vegetables | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 2. | MFT-302 | Food Quality Systems & Management | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 3. | MFT-303 | Food Packaging Technology | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 4. | MFT-304 | Food Engineering | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| 5. | MFT-305-307 | Departmental Elective | 3 | 1 | 0 | 20 | 10 | 30 | 70 | 100 | 4 |
| **PRACTICALS / PROJECT** | | | | | | | | | | | |
| 6. | MFT-351 | Post-Harvest Management lab | 0 | 0 | 4 | 20 | 10 | 30 | 70 | 100 | 2 |
| 7. | MFT-352 | Food Engineering Lab | 0 | 0 | 4 | 20 | 10 | 30 | 70 | 100 | 2 |
| 8. | MFT-354 | Seminar | 0 | 0 | 2 | - | - | 100 | - | 100 | 1 |
| | | **Total Credit** | **15** | **5** | **10** | | | **310** | **490** | **800** | **25** |

**IFTM UNIVERSITY, MORADABAD**
**COURSE STRUCTURE**
**M.Sc. (FOOD TECHNOLOGY)**
**(Effective from 2021-22)**
**Third Semester**

| **LIST OF DEPARTMENT ELECTIVES** | | |
|---|---|---|
| **S.No.** | **Course Code** | **Course Name** |
| 1 | MFT-305/306/307 | Meat, Poultry and Fish processing Technology/ Nutraceutical and functional foods/ Milk and Milk Product Technology / |

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-301: POST HARVEST MANAGEMENT OF FRUITS & VEGETABLES

**Objective(s):** The objective of this course:

- Aims to provide knowledge about the fruit and vegetable structure, post-harvest physiology and its spoilage.
- To understand the concepts of physiological characteristics of fruits and vegetables.
- To provide an insight about fruit losses during storage and ways to prevent it.

**UNIT I:** **(8 Sessions)**

**Introduction:** Importance & scope of post-harvest management of fruits and vegetables in Indian economy; Postharvest losses; type and extent of losses, causes, loss assessment, methods of loss reduction; Principles and methods of fruits and vegetables preservation, Types of storage – Natural, Ventilated, Low temperature.

**UNIT II:** **(8 Sessions)**

**Fruits and Vegetables**: Morphology, structure and composition of fruits and vegetables: Biochemical constituents; Maturity indices and standards for selected fruits and vegetables; Methods of maturity determinations.

**UNIT III**: **(8 Sessions)**

**Harvesting and Handling**: Importance of harvesting and handling of fruits and vegetables; Harvesting tools and their design aspects; Field heat of fruits and vegetables and primary processing for sorting and grading at farm and cluster level; Post Harvest handling system for fruits and vegetables of regional importance such as citrus, mango, banana, pomegranate, tomato, papaya and carrot etc,; factors affecting post-harvest losses; Commodity pretreatments - chemicals, wax coating, prepackaging, VHT and irradiation.

**UNIT IV:** **(8 Sessions)**

**Post-harvest physiological and biochemical changes**: Ripening of climacteric and non-climacteric fruits; regulations, methods; Physiological post-harvest disorders- Chilling injury and disease; prevention of post-harvest diseases and infestation.

**UNIT V:** **(8 Sessions)**

**Packaging and Transportation:** Packaging of fruits and vegetables; Storage practices- CA and MA, hypobaric storage, pre-cooling and cold storage, Zero energy cool chamber; packaging house operations; principles of transport and commercial transport operations.

**Course Outcomes:**

Students completing this course will be able to:

- Critically evaluate and reflect upon the physiological changes which occur in harvested horticultural produce in order to make appropriate post-harvest management decisions.
- Determinate of physiological disorders of fruit.
- Learn storage and cold chain management.
- Understand post-harvest management and its role in providing better quality produce to the consumer.

**Suggested Readings:**


1. Amalendu Chakraverty , Arun S. Mujumdar Handbook of Postharvest Technology: Cereals, Fruits, Vegetables,Tea, and Spices,2003.
2. AA Kadar, Post harvest technology. of Horticulture crops ,Third Edition: University of California, 2002
3. D K Salunkhe Handbook of vegetable science,1998.
4. TK Bose, Fruits of India: Tropical and subtropical, Publisher-Naya prakash, 1991.
5. R. Wills et al. Postharvest of fruit, vegetables & ornamentals; CAB International, (2007).


**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- http://ecoursesonline.iasri.res.in/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-302: FOOD QUALITY SYSTEMS & MANAGEMENT

**Objective:** The main objective of this course:

- Emphasis on introducing the students to the principles of food safety and sanitation. It focuses on the important areas of food borne diseases, food safety hazards and the effective management of food safety through the application of the risk management system Hazards Analysis Critical Control Point (HACCP).

**UNIT I:** **(8 Sessions)**

**Concept of quality:** Quality control; Importance and function of Quality control; Quality attributes- physical, chemical, nutritional, microbial, and sensory; their measurement and evaluation; Sensory *vis-à-vis* instrumental methods for testing quality, Methods of quality assessment of food materials- Fruits, Vegetables, Dairy products, cereals, Meat, Poultry and egg.

**UNIT II:** **(8 Sessions)**

**Quality management:** Objectives of quality management, Sampling procedures and plans; Quality management systems in India- Food Safety and Standards Act, 2006; Global Food safety Initiative; HACCP; Quality manuals, documentation and audits.

**UNIT III**: **(8 Sessions)**

**Various organizations:** Various organizations dealing with inspection, traceability and authentication, certification and quality assurance (PFA, FPO, MMPO, MPO, AGMARK, BIS); International scenario, International food standards- ISO and Food Codex.

**UNIT IV**: **(8 Sessions)**

**Quality assurance:** Total Quality Management; Food adulteration and food safety; Export import policy- WTO (SPS, TBT); export documentation; IPR and Patent; Labeling issues.

**UNIT V:** **(8 Sessions)**

**Quality procedures and applications:** Sanitary and hygiene practices (GMP, GHP, GLP); Sampling and specification of raw material and finish products; Applications in different food industries.

**Course Outcomes:**

Students completing this course will be able to:

- Familiarize with food safety hazards.
- Analyze hazards that might contaminate foods and causes of foodborne illnesses.
- Apply the Hazard Analysis Critical Control Point (HACCP) system as part of food safety and quality management.
- Emphasize on the importance of food safety, food quality, food laws and regulations in food industry.

**Suggested Readings:**


1. Amerine MA, Pangborn RM &Rosslos EB. Principles of Sensory Evaluation of Food. Academic Press, 2013.
2. Early R. Guide to Quality Management Systems for Food Industries, Blackie Academic, 2012.
3. Furia TE. Regulatory status of Direct Food Additives, CRC Press, 2018.

4. Jellinek G. Sensory Evaluation of Food - Theory and Practice, Ellis Horwoood,1985.
5. Krammer A &Twigg BA. Quality Control in Food Industry. Vol. I, II. AVI Publication, 1970.
6. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products, Tata-McGraw-Hill, 1986.

**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- http://ecoursesonline.iasri.res.in/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-303: FOOD PACKAGING TECHNOLOGY

**Objective(s):** The objectives of this course:

- Focuses on the packaging to minimize product losses (waste) throughout the food handling and distribution chain.
- Food packaging is to hold the food quality – ideally in the condition in which it was prepared by the food manufacturer – until it is ready to be consumed.
- The quality of food is to be retained as much as possible during the time between period of release and time of use.
- It requires a combination of properties and/or characteristics and although each recognized packaging material possesses some of these, sadly no one material possesses them all.

**UNIT I**: **(8 Sessions)**

**Materials Used For Food Packaging:** Packaging requirements and selection of packaging materials; Types of packaging materials: Paper: pulping, fibrillation and beating, types of papers and their testing methods; Glass: composition, properties, types of closures, methods of bottle making; Metals: Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminum containers, lacquers; Plastics: types of plastic films, laminated plastic materials, co-extrusion, edible films, biodegradable plastics.

**UNIT II:** **(8 Sessions)**

**Properties of Packaging materials**: Such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation.

**UNIT III:** **(8 Sessions)**

**Barrier properties of packaging materials**: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapor transmission rate (WVTR) and its measurement, prediction of shelf life of foods, selection and design of packaging material for different foods.

**UNIT IV:** **(8 Sessions)**

**Food packaging systems:** Different forms of packaging such as rigid, semirigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.

**UNIT V:** **(8 Sessions)**

**Packaging equipment and machinery**: Vacuum, CA and MA packaging machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machines; carton making machines.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the basic principles of packaging and to use it in the processing, preservation, distribution and promotion of food products, to familiarize themselves with the available packaging materials, to understand how to link materials to safety, quality and shelf life of foods and to compare packaging materials to each other and understand their differences and similarities. After finishing the lectures, students will be able to choose the appropriate packaging materials and types

in relation to the food that is to be packaged as well as to understand any problems that may occur due to inappropriate packaging

- Operate fill and seal machine, gas packaging machine, vacuum packaging machine, seal and shrink packaging machine, bottling Filling machine, cartoon making machine, ghee packaging machine, shear tester, drop tester , thickness tester, cobb tester vibration tester, cup yelling machine, slip friction tester, water vapor permeability tester.
- Check quality parameters of packaging material like drop test; crush test, shear test, thickness test, vibration test, slip friction test, cobb test.
- Explain various types of packaging method and check shelf life of powder foods.
- Explain various types of packaging material and their properties used in packaging of food product.

**Suggested Readings:**


1. Food packaging – Principles & Practice Gordon L Robertson
2. Ranganna..Handbook of Analysis and Quality Control for Fruit and Vegetable Products
3. N Shakuntalamany& M Shadaksharaswamy Foods: Facts and principles
4. Food Packaging Technology Hand book NIIR New Delhi


**Website Sources:**

- http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/food_technology/food_packaging_technology/01.introduction_to_food_packaging/et/2643_et_m1.pdf
- http://ecoursesonline.iasri.res.in/course/view.php?id=28
- https://www.kaznau.kz/page/GPIIR/UMCDzarubej/Rosnita%20Binti%20A%20Talib.pdf
- https://www.sanfoundry.com/food-engineering-questions-answers-food-packaging labelling/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-304: FOOD ENGINEERING

**Objective:** The main objective of this course:

- Is designed to emphasis on the various properties of the raw material used in food processing, different processing technologies required in transforming them into quality food products and material handling equipment involved in food processing operations.

**UNIT I**: **(6 Sessions)**

**Thermodynamics and Heat Transfer:** Principles of thermodynamics and heat transfer applied to food engineering; Mass Transfer; Modes of Heat Transfer – in solids and liquids; radiative heat transfer; Steady and Unsteady State Heat Transfer; Microwave Heating Fourier's Law; Stefan Boltzmann Law.

**UNIT II:** **(6 Sessions)**

**Kinetics of biological reactions:** kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction; quality changes during storage of foods; application of Arrhenius equation to biological reactions.

**UNIT III:** **(10 Sessions)**

**Method for thermal process evaluation:** Commercial sterility, pasteurization and sterilization methods based on slowest heating region; determination of the process time based on region of greatest temperature lag; the process equivalence in terms of minutes at 121.1°C; calculation of process time for fluids on stream line flow and turbulent flow heated in heat exchangers; general introduction to aseptic canning process, hydrostatic sterilizer and aseptic packaging practices and design problems.

**UNIT IV**: **(8 Sessions)**

**Food chilling and freezing:** Properties of frozen foods; freezing point depression; general introduction to enthalpy change during freezing; Plank's equation for predicting rates of product freezing; Cryogenic freezing and IQF; design of food freezing equipment such as air blast freezers, plate freezers and immersion freezers.

**UNIT V:** **(10 Sessions)**

**Mechanical Operations in Food Processing:** Size Reduction and Related Laws; Methods of Size Reduction – crushing, grinding; Equipment used for Size Reduction; Applications in a Food Processing Industry.

**Course Outcomes:**

Students completing this course will be able to:

- Identify the thermodynamic variables that will affect the food processing.
  To understand the energy balance involved in food processing operations.
- To understand the basic laws of heat transfer and account for the consequence of heat transfer in thermal analyses of engineering systems.
- To develop unit operation system for food processing.

**Suggested Readings:**


1. H. Pandey, H.K. Sharma, R.C.Chouhan, B.C. Sarkar and M.C. Bera, Experiments in Food Process Engineering, CBS Publishers and Distributors, 2004.
2. M.A. Rao, S.S. H.Rizvi and A.K.Dutta, Engineering properties of Foods, 3rd ed., Marcel Dekker, 2005.
3. ZekiBerk, Food process engineering and technology, first edition, 2009.
4. Aiba, Humphrey & Miller, Biochemical Engg., Academic Press, 1973.
5. Rao DG. Fundamentals of food engineering. PHI Learning Private Ltd, 2010.


**Website Sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- http://ecoursesonline.iasri.res.in/

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-305: Meat, Poultry and Fish processing Technology

**Objective**: The main objective of this course:

- To provide an understanding of the technology for handling, processing, preservation and by-product utilization of meat, poultry and fish products processing.

**UNIT I:** **(8 Sessions)**

**Introduction**: Status and scope of meat and poultry industry in India; Muscle- structure, chemical composition and physico-chemical properties of meat muscle, Effect of feed, breed and management on meat production and quality; nutritive value, conversion of muscle into meat.

**UNIT II:** **(8 Sessions)**

**Slaughter process:** Slaughtering of animals and poultry, post-mortem inspection and ante- mortem inspection; grading of meat; Factors affecting post-mortem changes, properties and shelf life of meat; Meat tenderization - natural and artificial methods; Modern abattoirs and design of facilities - typical layout and features.

**UNIT III:** **(8 Sessions)**

**Processing and preservation of meat:** Mechanical deboning, aging or chilling, freezing, pickling, curing, cooking and smoking of meat; Thermal processing- canning of meat, retort pouch, dehydration and irradiation; Meat Products - kebabs, mince, salami, sausages, meat emulsions, dried meat, meat extracts, ready to eat (RTE) meat products; Meat plant sanitation and waste disposal; by-product Utilization.

**UNIT IV:** **(8 Sessions)**

**Poultry**: Poultry industry in India, measuring the yields and quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plant; Poultry meat processing operations, equipment used – Defeathering, bleeding, scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.

**UNIT V:** **(8 Sessions)**

**Fish**: Commercially important marine products from India; product export and its sustenance; basic biochemistry and microbiology; preservation of postharvest fish freshness; transportation in refrigerated vehicles; deodorization of transport systems; design of refrigerated and insulated trucks; grading and preservation of shell fish; pickling and preparation of fish protein concentrate, fish oil and other by products

**Course Outcomes:**

Students completing this course will be able to:

- Understand the composition of flesh foods.
- Learnt about the chemistry of meat and various processing methods used for meat, fish and poultry.

**Suggested readings:**


1. Forrest JC. 1975. *Principles of Meat Science*. Freeman.
2. Govindan TK. 1985. *Fish Processing Technology*. Oxford & IBH.
3. Hui YH. 2001. *Meat Science and Applications*. Marcel Dekker.
4. Pearson AM & Gillett TA. 1996. *Processed Meat*. 3rd Ed. Chapman & Hall.

5. Stadelman WJ & Cotterill OJ. 2002. *Egg Science and Technology*. 4th Ed. CBS.

**Website sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- ecoursesonline.iasri.res.in

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-306 NUTRACEUTICAL AND FUNCTIONAL FOODS

**Objective**: The main objective of this course:

- To cater to the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals, product development, clinical testing and toxicity aspects.

**UNIT I:** **(8 Sessions)**

**Concept of Nutraceuticals and Functional Foods**: Definition and importance of nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods; Nutraceutical and functional food applications and their health benefits; Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions.

**UNIT II:** **(8 Sessions)**

**Metabolic aspects of Bioactive ingredients and Risk Reduction of diseases**: Nutraceuticals for specific situations such as-cancer, heart disease, stress, osteoarthritis, hypertension etc.; Antioxidants and other phytochemicals (isoflavones, lycopenes) their role as nutraceuticals and functional foods; Dietary fibers and complex carbohydrates as functional food ingredients; Protein as a functional food ingredient; Probiotic foods and their functional role; Herbs as functional, health promoting activity of common herbs.

**UNIT III:** **(8 Sessions)**

**Food products as functional foods**: Cereal products – oats, wheat bran, rice bran etc.; Functional vegetables products, oil seeds and sea foods; Coffee, tea and other beverages as functional foods/drinks and their protective effects.

**UNIT IV:** **(8 Sessions)**

**Clinical testing of nutraceuticals and health foods**: Interactions of prescription drugs and nutraceuticals; adverse effects and toxicity of nutraceuticals; nutrigenomics – an introduction and its relation to nutraceuticals.

**UNIT V:** **(8 Sessions)**

**Regulatory status and laws governing Functional foods and Nutraceuticals:** Marketing and regulatory issues for functional foods; Health Claims: Disease Risk Reduction Claims, regulatory issues for nutraceuticals including CODEX; Recent developments and advances in the area of nutraceuticals and functional foods.

**Course Outcomes:**

Students completing this course will be able to:

- Understand components of nutraceutical and functional foods.
- Understand the definition, classification of nutraceuticals, functional foods and dietary supplements and role of nutraceuticals in prevention or cure various diseases.

**Suggested readings:**


1. Brigelius-Flohé, J & Joost HG. 2006. Nutritional Genomics: Impact on Health and Disease. Wiley VCH.
2. Cupp J & Tracy TS. 2003. Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
3. Gibson GR & William CM. 2000. Functional Foods - Concept to Product.
4. Goldberg I. 1994. Functional Foods: Designer Foods, Pharma Foods.

**Website sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- ecoursesonline.iasri.res.in

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

## MFT-307: Milk and Milk Product Technology

**Objective**: The main objective of this course:

- To acquaint with techniques and technologies of testing and processing of milk into various products and by products.

**UNIT I:** **(8 Sessions)**

**Present status of milk & milk products in India and abroad**: Market milk-Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.

**UNIT II:** **(8 Sessions)**

**Cream and Butter**: Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter.

**UNIT III:** **(8 Sessions)**

**Condensed and Dried milk:** Definition, methods of manufacture, evaluation of condensed & evaporated milk; Dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder.

**UNIT IV:** **(8 Sessions)**

**Ice cream and cheese**: Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture; Cheese- Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.

**UNIT V:** **(8 Sessions)**

**Indigenous milk products**: Present status, method of manufacture of yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rasogulla, shrikhand, chhana, paneer, ghee, lassi etc; probiotic milk products.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the various constituents of milk and milk products
- Understand the technology behind the production of various dairy products.

**Suggested readings:**


1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. Technology of Indian Milk Products. Dairy India Publ.
2. Rathore NS et al. 2008. Fundamentals of Dairy Technology - Theory & Practices. Himanshu Publ.
3. De Sukumar, Outlines of Dairy Technology, Oxford University Press, 1991.
4. P.Walstra, DairyTechnology: Principles of Milk Properties and Processes, First ed., CRC Press, 1999.
5. Web BH, Johnson AH & Lford JA. 1987. Fundamental of Dairy Chemistry. 3rd Ed. AVI Publ.

**Website sources:**

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- ecoursesonline.iasri.res.in

**IFTM University, Moradabad**

**Master of Science (M.Sc.), Programme**

**M.Sc. Food Technology II Year (III Semester)**

**(Effective from 2021-22)**

## MFT -351: Post Harvest Technology

| | | |
|---|---|---|
| **1.** | Introduction of Laboratory Practices | |
| **2.** | Safety Measures | |
| **3.** | Do and Don't | |
| **4.** | About Equipment and Accessories and Working | |
| **5.** | To study the maturity and maturity indices of fruits and vegetables | Experiment 1 |
| **6.** | Determination of soluble solids and acidity of a given samples. | Experiment 2 |
| **7.** | To study the effect of pretreatment on fruits and vegetables | Experiment 3 |
| **8.** | Determination of reducing sugar and total sugar of given samples | Experiment 4 |
| **9.** | Preparation of fruit preserve | Experiment 5 |
| **10.** | To study the effect of drying on various fruits and vegetables | Experiment 6 |
| **11.** | Preparation of Santra Marmalade | Experiment 7 |
| **12.** | To study the nature and cause of deterioration in fruits and vegetables | Experiment 8 |

**IFTM University, Moradabad**
**Master of Science (M.Sc.), Programme**
**M.Sc. Food Technology II Year (III Semester)**
**(Effective from 2021-22)**

**MFT -352: Food Engineering**

| | | |
|---|---|---|
| **1** | Introduction of Laboratory Practices | |
| **2** | Safety Measures | |
| **3** | Do and Don't | |
| **4** | About Equipment and Accessories and Working | |
| **5** | To prepare a plant layout for a sample food plant or for the laboratory | Experiment 1 |
| **6** | To study drying and drying characteristics of a given food materials | Experiment 2 |
| **7** | To study the process of elevation of boiling points | Experiment 3 |
| **8** | To study the different types of dryers in food engineering | Experiment 4 |
| **9** | To carry out the freezing of given fruit and vegetable samples | Experiment 5 |
| **10** | To study the various types of heat exchanger used in food industry | Experiment 6 |
| **11** | To study the freezing characteristics (freezing point depression in solution) | Experiment 7 |
| **12** | To compare conventional processing methods with microwave processing of foods | Experiment 8 |

**IFTM UNIVERSITY, MORADABAD**
**COURSE STRUCTURE**
**M.Sc. (FOOD TECHNOLOGY)**
**(Effective from 2021-22)**
**Fourth Semester**

| S.N. | Module Code | Module Name | Periods | | | EVALUATION SCHEME | | | | Course Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Mid Sem Exam | AS +AT | Total | End Sem Exam | | |
| **PRACTICAL** | | | | | | | | | | | |
| 1. | MFT-482 | Dissertation | 0 | 0 | - | - | - | 150 | 250 | 400 | 20 |
| | | **Total Credit** | | | | | | **150** | **250** | **400** | **20** |