# B.Sc (Hons.) 2020-21
**MICROBIAL & FOOD TECHNOLOGY**

<table>
<thead>
<tr>
<th>PAPERS CODE</th>
<th>TITLE</th>
<th>DURATION</th>
<th>MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(B.Sc PART I)</strong></td>
<td>Semester I</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER I</td>
<td>BMF 1001</td>
<td>General and Food Microbiology</td>
</tr>
<tr>
<td></td>
<td>BMF 1051</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER II</td>
<td>BMF 1002</td>
<td>Microbial and Food Biochemistry</td>
</tr>
<tr>
<td></td>
<td>BMF 1052</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER III</td>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper A</td>
<td>Inorganic Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper B</td>
<td>Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER IV</td>
<td>BMF 1002</td>
<td>Paper A</td>
</tr>
<tr>
<td></td>
<td>BMF 1050</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER III</td>
<td>Paper B</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td></td>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER IV</td>
<td>BMF 1002</td>
<td>Paper B</td>
</tr>
<tr>
<td></td>
<td>BMF 1050</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER V</td>
<td>Environmental Science (same as for B.Sc. Pass Course Students)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Qualifying)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Semester II**

<table>
<thead>
<tr>
<th>PAPERS CODE</th>
<th>TITLE</th>
<th>DURATION</th>
<th>MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PAPER I</td>
<td>BMF 2001</td>
<td>Industrial Microbiology and Fermentation Technology</td>
</tr>
<tr>
<td></td>
<td>BMF 2051</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER II</td>
<td>BMF 2002</td>
<td>Principles of Food Preservation and Packaging</td>
</tr>
<tr>
<td></td>
<td>BMF 2052</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER III</td>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper A</td>
<td>Inorganic Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper B</td>
<td>Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER IV</td>
<td>BMF 2002</td>
<td>Paper A</td>
</tr>
<tr>
<td></td>
<td>BMF 2050</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER V</td>
<td>Environmental Science (same as for B.Sc. Pass Course Students)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Qualifying)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PAPER VI Job Training: Four weeks training in a reputed Industry / Institution after B.Sc. – IIrd SEMESTER Final exams*.

**TOTAL MARKS** | **700**

<table>
<thead>
<tr>
<th>PAPERS CODE</th>
<th>TITLE</th>
<th>DURATION</th>
<th>MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(B.Sc PART II)</strong></td>
<td>Semester III</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER I</td>
<td>BMF 3001</td>
<td>Bioanalytical Techniques</td>
</tr>
<tr>
<td></td>
<td>BMF 3051</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER II</td>
<td>BMF 3002</td>
<td>Processing of Foods of Plant Origin</td>
</tr>
<tr>
<td></td>
<td>BMF 3052</td>
<td>Practical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER III</td>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper A</td>
<td>Inorganic Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper B</td>
<td>Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PAPER IV</td>
<td>BMF 3002</td>
<td>Paper A</td>
</tr>
<tr>
<td></td>
<td>BMF 3050</td>
<td>Practical</td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER IV

<table>
<thead>
<tr>
<th>Paper I</th>
<th>BMF 4001</th>
<th>Microbial Genetics and r-DNA Technology</th>
<th>3 hrs.</th>
<th>75 (67+8*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMF 4051</td>
<td>Practical</td>
<td></td>
<td>3 hrs.</td>
<td>25 (22+3*)</td>
</tr>
<tr>
<td>Paper II</td>
<td>BMF 4002</td>
<td>Processing of Food of Animal origin</td>
<td>3 hrs.</td>
<td>75 (67+8*)</td>
</tr>
<tr>
<td>BMF 4052</td>
<td>Practical</td>
<td></td>
<td>3 hrs.</td>
<td>25 (22+3*)</td>
</tr>
<tr>
<td>Paper III</td>
<td>Chemistry</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Paper A</td>
<td>Inorganic Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper B</td>
<td>Organic Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Paper IV | ENG | 50 |

PAPER V Job Training: Four weeks training in a reputed Industry / Institution after B.Sc. – IVth SEMESTER Final exams*.

**TOTAL MARKS**

700

### SEMESTER V

<table>
<thead>
<tr>
<th>Paper I</th>
<th>BMF 5001</th>
<th>Environmental Microbiology</th>
<th>3 hrs.</th>
<th>75 (67+8*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMF 5051</td>
<td>Practical</td>
<td></td>
<td>3 hrs.</td>
<td>25 (22+3*)</td>
</tr>
<tr>
<td>Paper II</td>
<td>BMF 5002</td>
<td>Food Analysis and Quality Control</td>
<td>3 hrs.</td>
<td>75 (67+8*)</td>
</tr>
<tr>
<td>BMF 5052</td>
<td>Practical</td>
<td></td>
<td>3 hrs.</td>
<td>25 (22+3*)</td>
</tr>
<tr>
<td>Paper III</td>
<td>Chemistry</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Paper A</td>
<td>Inorganic Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper B</td>
<td>Organic Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SEMESTER VI

<table>
<thead>
<tr>
<th>Paper I</th>
<th>BMF 6001</th>
<th>Entrepreneurship and intellectual property rights</th>
<th>3 hrs.</th>
<th>75 (67+8*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMF 6051</td>
<td>Practical</td>
<td></td>
<td>3 hrs.</td>
<td>25 (22+3*)</td>
</tr>
<tr>
<td>Paper II</td>
<td>BMF 6002</td>
<td>Food Engineering</td>
<td>3 hrs.</td>
<td>75 (67+8*)</td>
</tr>
<tr>
<td>BMF 6052</td>
<td>Practical</td>
<td></td>
<td>3 hrs.</td>
<td>25 (22+3*)</td>
</tr>
<tr>
<td>Paper III</td>
<td>Chemistry</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Paper A</td>
<td>Inorganic Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper B</td>
<td>Organic Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper C</td>
<td>Physical Chemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper D</td>
<td>Practicals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Project Work (70 marks) +Job Training done after II\(^{nd}\) and IV\(^{th}\) SEMESTER Examination (30 marks)  
* Marks for job training done in B.Sc I and B.Sc II to be credited in B.Sc III

**TOTAL MARKS**

700

**GRAND TOTAL (I-VI SEMESTER)**

2100

*Note: * Denotes marks for the Internal Assessment.
BMF 1001 – GENERAL AND FOOD MICROBIOLOGY

Instructions for the Examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: To introduce to students fundamental concepts of microbiology which includes microbial diversity, their morphological and functional properties, techniques to study microorganisms, growth and control of microorganisms as well as food spoilage and its control. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I

1. Introduction – Discovery of microbial world, Importance of microbiology, Microbial classification and nomenclature, Characteristics of major groups of microorganisms: Archaeabacteria, Eubacteria, Fungi, Protozoa and Viruses and Bacteriophages.

2. Prokaryotic cell structure and function: Cell morphology; the capsule and slime layer; cell wall; cell membrane; ribosome; flagella; fimbriae and pilli; nuclear region and spores.

3. Microbial Nutrition: Nutritional requirements of microbes; Types of culture media; Classification of microbes on the basis of nutritional requirements, Identification of bacteria.

UNIT II

4. Bacterial Growth - Bacterial growth curve, Methods of measurement of growth, Bacterial growth at high and low temperature; Other environmental factors affecting microbial growth, Synchronous and Diauxic growth.


6. Human-Microbial Interactions: Normal flora –Gastrointestinal tract; Pathogenic mechanisms of food borne bacteria, Brief account of mechanisms of action of chemotherapeutic agents, Introduction to specific and nonspecific defense mechanisms to infections.

UNIT III

7. Food-borne Pathogens: General characteristics and brief account of food borne diseases caused by - Staphylococcus aureus; Clostridium botulinum; C. perfringen; Listeria monocytogene; Salmonella; Escherichia.coli; Yersinia enterocolitica; Vibrio parahaemolyticus, Mycotoxins.


UNIT IV

9. Food Spoilage - Contamination of foods from natural sources, Intrinsic and Extrinsic parameters of food that affect microbial growth, Associations of microorganisms involved in spoilage, Physical and Chemical changes in food caused by micro-organisms.

B.Sc. PART I
(MICROBIAL AND FOOD TECHNOLOGY)
FIRST YEAR EXAMINATION
SEMESTER I

BMF 1002 – MICROBIAL AND FOOD BIOCHEMISTRY

MAX. MARKS: 75
PRACTICAL: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS

Time: 3 hours

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: The paper provides basic information on chemical, physical and functional properties of various biomolecules present in food and how they contribute to the overall quality of foods. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I

1. Introduction to Biomolecules - Major and minor constituents of food, Bioavailability of nutrients, their functions, sources, Basics of bioenergetics.
2. Enzymes- Enzymes classification and nomenclature; coenzymes, cofactor, kinetics, factors affecting catalytic efficiency of enzymes, allosteric enzymes, feed back inhibition; Competitive and non competitive inhibition.
3. Carbohydrates - Classification, structure & properties, Catabolism of carbohydrates- glycolysis, TCA, electron transport chain, Pentose phosphate pathway, Entnner Doudoroff pathway, Fermentation, Anaerobic respiration; artificial sweeteners.
5. Lipids - Classification, Structure and functions- saturated, unsaturated and phospholipids, Catabolism of fatty acids- Alpha and Beta oxidation pathways.

UNIT III
6. **Biosynthetic Pathways**: Brief account of Biosynthesis of sugars and polysaccharides, amino acids, nucleotides, fatty acids and lipids in prokaryotes, biosynthesis of bacterial cell wall.


8. **Vitamins and minerals** - Classification, sources and functions.

9. **Pigments** – Introduction, major types and sources, Food pigments - Chlorophyll, carotenoids, anthocyanins, flavonoids, beet pigments, caramel.

10. **Flavours** - Definition and basic taste factors, chemistry of food flavors from cocoa, coffee, vanilla beans and spices, flavor changes in fats and oil, flavor and aroma’s of food.

11. **Changes in food constituents during processing**: Changes in carbohydrates on cooking, Browning and Maillard reactions, Effects of physic-chemical conditions on proteins, Denaturation of proteins, Oxidative and Hydrolytic Rancidity.

**REFERENCE BOOKS –**

PRACTICAL
B.Sc. PART I, FIRST YEAR EXAMINATION
(MICROBIAL AND FOOD TECHNOLOGY)
SEMESTER I

BMF 1051 – (GENERAL AND FOOD MICROBIOLOGY)
MAX. MARKS: 25
PRACTICAL: 22 MARKS
INTERNAL ASSESSMENT: 3 MARKS
Time : 3 hours

1. Introduction and study of microbiological instruments.
2. Media preparation, aseptic techniques and transfer of microorganisms.
3. To study various culture techniques- pour plating, spread plating and streaking.
4. Microscopy: study, use and care of compound microscope.
5. To study effect of chemical disinfectants on bacterial growth by filter paper disc method.
6. To study morphology of bacteria by simple staining and negative staining.
7. Principle, procedure and use of gram staining method.
8. Staining of bacterial spores.
9. To distinguish the growth characteristics of microorganisms in various differential and selective media.
10. Identification of fungi by Lactophenol cotton blue staining method.
11. Sampling and observation of microorganisms from natural sources.
12. To study serial dilutions of the sample and plate counts.
13. To perform antibacterial testing by Kirby-Bauer method.
15. Presumptive coliform test for milk, butter and ice-cream.
16. Yeast and mold count for butter and dahi.

BMF -1052 (MICROBIAL AND FOOD BIOCHEMISTRY)
MAX. MARKS: 25
PRACTICAL: 22 MARKS
INTERNAL ASSESSMENT: 3 MARKS
Time : 3 hours

1. Qualitative analysis of carbohydrates.
2. Qualitative analysis of amino acids.
3. Determination of pK and pI values of an amino acid.
4. To perform isoelectric precipitation of proteins.
5. Quantitative estimation of amino acids by ninhydrin.
6. Determination of acidity and pH of food product.
7. Determination of Protein by kjeldhal method.
9. Determination of acid value in given oil.
10. Determination of melting points of different types of oils.
15. Determination of ash content and different types of ash.
Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified

Objectives: To provide an insight into the basic principles of Fermentation Technology and Downstream Processing which involves strain selection, media formulation, sterilization, inoculum development, design of bioreactors and product recovery. Paper also deals with production and use of various fermented products. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I
1. Introduction – Importance of fermentation technology, Basic steps of industrial fermentation; Primary and Secondary metabolites.
2. Industrially important microbes – Industrially important microbes; Isolation and Screening, Improvement and Preservation of Industrial microorganisms.
3. Fermentation media and inoculum development – Medium formulation and common substrates used in fermentation industry; Methods of media sterilization,

4. Fermentation – Types of fermentations- Aerobic and anaerobic fermentation, Submerged and solid state fermentation, Batch and Continuous fermentation systems.
5. Design of Fermenter – Design and types of fermenter, antifoam agents, sterilization of fermenter, Basic Control Panels (aeration, agitation, pH and temperature).
6. Downstream Processing of industrial fermentations – General procedures for recovery and purification of products- separation of biomass and insolubles; cell disruption and recovery and purification.

7. Alcoholic beverages and Solvent: Industrial production of Beer, Wine and Ethanol
8. Organic acids: Acetic Acid, Citric Acid, Lactic acid.

UNIT IV
10. Microbial Biomass: Single cell protein production
11. Microbial Enzymes: Industrial production of microbial enzymes-amylase and protease; Immobilization of enzymes and their applications.

REFERENCE BOOKS

**B.SC PART I**

**MICROBIAL AND FOOD TECHNOLOGY**

**FIRST YEAR EXAMINATION**

**SECOND SEMESTER**

**BMF 2002 - PRINCIPLES OF FOOD PRESERVATION AND PACKAGING**

**MAX. MARKS: 75 MARKS**

**THEORY: 67 MARKS**

**INTERNAL ASSESSMENT: 8 MARKS**

**TIME: 3 HRS.**

**Instructions for the examiner:** The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**Objectives:** The paper deals with different methods of food processing and preservation methods, recent advances and food packaging concepts. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

**UNIT I**

1. **Introduction** - General principles of food preservation, Historical development.
2. **Preservation by Heat** - Heat transfer, Heat treatments – Blanching; Pasteurization; Sterilization; Boiling and Canning , TDT Curve, D value, F value,12D concept.
3. **Refrigeration & Freezing of foods** – Differences between - refrigeration and freezing; Effect of refrigerated and frozen storage on food; Immersion freezing.
4. **Preservation by Drying** - Drying curve, Factors affecting drying, Methods of drying & dehydration - Air convection dryers; Fluidized bed drier; roller drier; vacuum drier; spray drier; Freeze – Drying, Intermediate Moisture foods.
5. **Preservation by Concentration** - Methods of concentration, Types of Evaporators.
6. **Preservation by Radiations** - Types of Radiations, Effects of Radiations, Dose – Determining Factors, Status of Irradiated foods in India, Microwave, Ohmic heating.
7. **Preservation by Chemicals** - GRAS, Chemical food preservatives, Food Additives.
8. **Recent Trends in Food Processing** – Overview of Extrusion cooking, Reverse Osmosis, Electrode dialysis, Ultrafiltration, High Pressure Processing. Pulse electric field preservation.
9. **Super critical fluid extraction, Fat mimetics** – Introduction, principle and procedure, application & advantages of super critical fluid extraction. Carbohydrate and protein mimetics, fat substitutes, synthetic fat replacers.
10. **Packaging Materials** - Properties of packaging materials in relation to their functions (Paper, Glass, Jute, Wood, Metal containers, Flexible packaging materials,
Laminates), edible packaging, Nanocomposite in food packaging.

11. **Packaging Methods** - Form fill seal packaging, Hermetic closures, Retortable pouches, Aseptic packaging, Inert gas packaging, Active & Intelligent Packaging, vacuum packaging, CAP and MAP.

12. **Packaging of Food Products** - Description of packaging of -
   a) Frozen products
   b) Dried products
   c) Chemically preserved foods
   d) Fats and oils
   e) Confectionery and bakery
   f) Fruit juices
   g) Heat processed foods
   h) Fresh produce (Eggs, Meat, Fruits and Vegetables)

**REFERENCE BOOKS –**

1. Screening of microbes producing industrially important enzyme.
2. Maintenance and preservation of pure culture.
3. Determination of cell biomass.
5. To study the effect of energy source and role of buffers on the growth of microbes.
6. To study the effect of temperature and pH on the growth of microbes.
7. To study the effect of aeration and substrate concentration on the growth of bacteria.
8. Isolation of LAB in pure culture.
11. To study solid state and submerged fermentation techniques.
12. To study probiotic bacteria.
13. Lab scale production of an enzyme.
14. Lab scale preparation of ethanol.
15. Study of Cell/enzyme immobilization techniques.

1. To blanch a seasonal fruit or vegetable & assess quality of blanching process.
2. To study the effect of browning on raw fruits & vegetables.
3. Preparation of drying curve.
4. To study effect of heat and acidity on milk proteins.
5. To study the effective-ness of pasteurization by phosphatase test.
6. To study Pasteurization of milk using microwave technique.
7. To study the different packaging materials.
8. Determination of water vapour transmission rate for various packaging materials.
9. To determine grease resistance of packaging material.
10. To determine the wax content in given wax paper.
11. To estimate the basis weight of given packaging material.
13. Determination of uniformity of tin coating and tin crystal size on given tin plate.
14. To study the effect of addition of different chemical preservatives on food quality.
15. To study the synergistic / antagonistic combination of GRAS additives.

B.Sc. PART II
(MICROBIAL AND FOOD TECHNOLOGY)
SECOND YEAR EXAMINATION
THIRD SEMESTER

BMF 3001– BIOANALYTICAL TECHNIQUES

MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS.

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: The paper is designed to impart knowledge on basic principle, types, technique and applications of various analytical instruments viz chromatography, electrophoresis, spectroscopy etc. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I

1. Microscopy - Principle and applications of Bright field, Fluorescence, Dark field and Electron microscopy, Direct Epifluorescent Filter Technique, Fixation and Staining.
3. Centrifugation: Principles and applications of Density gradient and Differential centrifugation; Ultracentrifugation.

UNIT II

4. Electrophoresis – Types of electrophoresis; Principles and application of Agarose Gel Electrophoresis; SDS-Page electrophoresis; Immuno electrophoresis and 2-D Electrophoresis.
5. Refractometry - Basic Principle; specific and molar refractions; Refractometers-Principle and its Applications.
6. Polarimetry - Basic principle of Polarimeter and its applications

UNIT III

7. Spectroscopy - Basic principle of absorption of light, Principle and applications of UV and Visible; Atomic absorption; Nuclear magnetic resonance and Mass spectroscopy.
8. Fluorescence spectroscopy - Fluorescence methods; filter fluorometers; Fluorosence Spectrophotometer

UNIT IV

10. Biosensors: Principle; types and applications of biosensors.
11. **Tracer techniques**: Use of radioisotope, detection and measurement of radioactivity; specific activity; applications in food sector.

**REFERENCE BOOKS –**


**B.Sc. PART II**

(MICROBIAL AND FOOD TECHNOLOGY)

SECOND YEAR EXAMINATION

THIRD SEMESTER

BMF 3002- PROCESSING OF FOODS OF PLANT ORIGIN

MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS.

*Instructions for the examiner:* The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

**Objectives:** To introduce to students to post harvest processing of fruits, vegetables, cereals, pulses and oil seeds, FPO standards of processed fruit and vegetable products, preparation of processed foods of plant origin and their utilization. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

**UNIT I**

1. Physiology of ripening, Effect of physical and chemical treatments on post harvest life of fruits and vegetables, Storage and handling of fresh fruits and vegetables, Preparation of fruits and vegetables for processing, Preparation of fruit juices and pectin.
2. FSSAI/FPO Standards and preparation of jam, jellies, marmalades, tomato products, preserves and pickles.
3. By– product utilization of fruits and vegetable processing industry.
4. Structure and composition of different grains like wheat, rice, etc. Milling of wheat. Flour quality, Technology of baking bread, biscuit and cereal based infant foods.
5. Milling and parboiling of rice, Rice bran oil, Wet and dry milling of corn.
6. Breakfast cereals – Porridge and flakes
UNIT III
7. Nutritional value of pulses.
9. Anti nutritinal component of pulses, Application of enzymes in processing of cereals and pulses.

UNIT IV
11. Extraction and purification of oils, preparation of various products including margarine, salad dressing & mayonnaise.
12. Nutritional food mixes from oilseeds – Oilseeds for food use

REFERENCE BOOKS –

PRACTICAL
B.Sc. PART II
(MICROBIAL AND FOOD TECHNOLOGY)
SECOND YEAR EXAMINATION
SEMESTER III

BMF 3051 – BIOANALYTICAL TECHNIQUES

MAX. MARKS: 25 MARKS
THEORY: 22 MARKS
INTERNAL ASSESSMENT: 3 MARKS
TIME: 3 HRS.

1. Determination of molar absorption coefficient of L-tyrosine
3. Quantitative estimation of total sugars by anthrone method.
5. Separation of amino acids by paper electrophoresis.
6. Separation of blue dextran and potassium dichromate by gel-filteration chromatography.
7. Separation of plant pigments by TLC.
8. Separation of lipids by TLC.
12. Estimation of total serum cholesterol by Zak & Henly’s method
15. To study the effect of ultraviolet light on Vitamin A.

**PRACTICAL**

_B.Sc. PART II_  
_(MICROBIAL AND FOOD TECHNOLOGY)_

SECOND YEAR EXAMINATION

SEMESTER III

**BMF 3052- PROCESSING OF FOODS OF PLANT ORIGIN**

:max: 25 marks

**THEORY: 22 MARKS**

**INTERNAL ASSESSMENT: 3 MARKS**

**TIME: 3 HRS**

1. Estimation of Ascorbic Acid content spectrophotometrically.
2. Determine Brix : Acid ratio of fruits and vegetable products.
3. To study the physical characteristics of cereals.
4. Estimation of WAP and Gluten content of wheat flour.
5. Estimation of particle size of different types of flour.
6. Determination of physical characteristics (Specific gravity, Refractive index & Melting point ) of Peanut Butter.
8. Determine free fatty acid value of a given oil sample.
9. Qualitative and Quantitative determination of oil rancidity.
10. Determination of Sulphur Dioxide in processed fruits and vegetables
11. Estimation of total aldehydes by hydroxylamine titration in citrus oils.
12. Preparation of jellies and marmalades.
13. Quality evaluation of wheat flour
14. Determination of starch gelatinization from different plant sources.
15. Estimation of Trypsin Inhibitor / cyanogenic glucosides in pulses.
B.Sc. PART II
(MICROBIAL AND FOOD TECHNOLOGY)
SECOND YEAR EXAMINATION
FOURTH SEMESTER

BMF 4001 – MICROBIAL GENETICS & r-DNA TECHNOLOGY

MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS

TIME: 3 HRS Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: To make the students understand the fundamental concepts of genetics which includes DNA structure, replication, transcription, translation, mutation, gene regulation and techniques related to genetic engineering. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I
1. Genome organization in prokaryotes – Molecular nature of the genetic material, Composition and structure of prokaryotic DNA and RNA, Types of RNA.
2. DNA Replication- DNA replication mechanism in prokaryotes, Enzymes involved in DNA replication, theta and sigma modes of replication.

UNIT II
5. Genetic Exchange – Gene transfer by Transformation; Generalized and Specialized transduction; Conjugation processes.

UNIT III
7. Recombinant DNA Technology- Tools of genetic engineering- DNA cloning vectors- Plasmids, Cosmids, Phage vectors, Shuttle vectors, Expression vectors, BAC/YAC vectors; Restriction endonuclease, DNA ligase, Alkaline phosphatase, DNA polymerase, Exonuclease.
8. Gene cloning – Basic techniques used to identify, amplify and clone genes; Construction of genomic and cDNA libraries and Screening of DNA libraries.
9. Applications of Recombinant DNA Technology in health and food sector.

UNIT IV
10. DNA Transferring Mechanisms – Chemical methods, biolistic gun, Electroporation, Liposome mediated gene transfer and phage transfection.
11. DNA amplification- PCR; Types and Applications.
12. Techniques of molecular biology- Dot- Blot, Southern blotting, Northern blotting and Western blotting techniques, DNA sequencing by Maxam-Gilbert, Dideoxy...
chain termination and Automated dideoxy method, Oligonucleotide mediated site directed mutagenesis.

REFERENCE BOOKS

B.Sc. PART II
(MICROBIAL AND FOOD TECHNOLOGY)
SECOND YEAR EXAMINATION
FOURTH SEMESTER

BMF 4002- PROCESSING OF FOODS OF ANIMAL ORIGIN
MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: The paper provides an insight to milk composition, milk processing techniques, milk products, meat structure and processing as well as egg and fish technology. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I
1. FSSAI/PFA Definition of milk; Chemical composition of milk of different species i.e. Buffalo, Cow (foreign), Cow (sindhi), Goat, Murrah, Jersey.
2. Diagrammatic representation of milk constituents; Factors affecting milk composition. Physico – chemical properties of milk, Production, distribution and storage of liquid milk
3. Processing of different types of market milk – Pasteurized, Sterilized, Homogenized,
4. Definition, composition and technology of milk products –
   a. Butter.
   b. Ghee.
   c. Ice cream.
   d. Evaporated and condensed milk.
   e. Dried milk.
6. Cheese – Definition, composition and types of cheese; Basic steps in cheese making; Cheddar cheese, Cottage cheese, Blue cheese, Mozzarella cheese and Processed cheese.

UNIT III
7. Chemistry and microscopic structure of meat tissue; Meat pigments and color changes.

UNIT IV
12. Nutritional value of fish; procurement of fish. Canning of fish and fish products; Fish products – Fish oil, Fish flour, Fish sauce, Dried fish meal and Fish protein concentrates.
REFERENCE BOOKS –

1. De, Sukumar (2012). *Outlines of dairy technology*. Oxford Univ. Press, ND

PRACTICAL
B.Sc. PART II
(MICROBIAL AND FOOD TECHNOLOGY)
SECOND YEAR EXAMINATION
SEMESTER IV

BMF 4051 (MICROBIAL GENETICS & R- DNA TECHNOLOGY)
MAX. MARKS: 25 MARKS
THEORY: 22 MARKS
INTERNAL ASSESSMENT: 3 MARKS
TIME: 3 HRS

1) Preparation of reagents involved in DNA work.
2) Isolation of genomic DNA from bacteria.
3) Estimation of DNA by Diphenylamine method.
4) Isolation of plasmid DNA.
5) Preparation and running of agarose gel and detection of DNA on the gels.
6) Estimation of RNA content by the Orcinol method.
7) Effect of U.V. radiations on bacterial growth.
8) Demonstration of photoreactivation repair mechanism in bacteria.
9) Isolation of nutritional mutants.
11) Selection of Antibiotic resistant variants by gradient plate method.
12) Spectrophotometric quantitative estimation of DNA.
1. To check the heat stability of milk by COB and Alcohol tests.
3. Determination of specific gravity, SNF % and TS% of milk.
4. Estimate the milk fat by Gerber method.
5. To determine the Casein content of the milk.
6. To check the sterility of milk by Turbidity test.
7. Bacteriological estimation of milk by MBRT.
8. Physical and chemical analysis of milk & milk products
9. To estimate the salt content in butter.
11. To estimate the purity of ghee by Baudouin test.
12. Testing the adulteration in milk & milk products
13. Preparation of Ghee by different methods.
14. Quality of egg & egg powder, egg preservation.
15. Evaluation of quality of meat, fish & poultry
BMF 5001: ENVIRONMENTAL MICROBIOLOGY

MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: The paper basic knowledge on microbial diversity in natural sources, microbial interactions and adaptations, role of microorganism in maintenance of life on earth and in water quality. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I
1. Soil Microbiology: Composition of soil, Enrichment, Isolation and characterization of soil microbes and their products; Soil enzymes as indicator of ecosystem.
2. Biological Interactions: Microbial interactions (positive, negative and neutral): Mutualism, protocooperation, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non symbiotic interactions

UNIT II
3. Biogeochemical Cycling: Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin
Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction.
Phosphorus cycle: Phosphate solubilisation.
Sulphur cycle: Microbes involved in sulphur cycle.
Water cycle
4. Biofertilizer and Biopesticides: Microbial Biofertilizers, Biopesticides; Advantages over chemical fertilizers and pesticides.
5. Bioremediation, Bioabsorption and Biodegradation: Introduction to microbiology of bioremediation; Microbial biodegradation of toxic chemicals, Bioabsorption, Microbial deterioration of paper, wood and textiles,

UNIT IV
7. Solid Waste Management: Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (Landfilling, Trench method, Composting and Vermicomposting).
8. Liquid Waste Management: BOD and COD, Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment; Bacterial indicators of water safety, waste water treatment by biofilms.
REFERENCE BOOKS –


B.Sc. PART III
(MICROBIAL AND FOOD TECHNOLOGY)
THIRD YEAR EXAMINATION
FIFTH SEMESTER

BMF 5002 – FOOD ANALYSIS AND QUALITY CONTROL

MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: The paper focuses on physical, chemical, microbial and sensory analysis of food, concepts of quality control and quality management, national and international food loss and adulterants in various food products. The syllabus of this paper is designed not only to give theoretical knowledge but 25% weightage is given to impart hands on training to enhance the skills.

UNIT I

1. **Sampling** – Sampling techniques and preparation of food samples. Sampling of Milk, Fruit and Vegetable products; Eggs; Dried & Frozen food products.

2. **Proximate analysis of food**
   i. Moisture
   ii. Carbohydrates
   iii. Proteins
   iv. Fats
   v. Crude Fiber
   vi. Ash content and its composition
   vii. Minerals
   viii. Vitamins

3. Physico chemical properties, TS, TSS, Acidity, solubility, sedimentation etc.
UNIT II

4. **Sensory assessment of food quality** –
   i. Appearance of food – Size, Shape & Colour.
   ii. Flavor of food – Taste & Smell, Subjective & Objective analysis.
   iii. Texture of food – Concept of Rheology & Viscosity, Subjective & Objective Analysis.

5. **Sensory Tests** –
   i. Difference, Rating & Sensitivity tests.
   ii. Types of panels
   iii. Testing area & schedule.

6. **Quality control of following food products** –
   (i) Milk & milk products
   (ii) Oils & Fats
   (iii) Cereal grains & flours
   (iv) Fruits & vegetable products
   (v) Canned foods (vi) Egg
   & egg products (vii) Meat
   & Meat products

7. **Adulterants and Preservatives** – Common adulterants present in milk, tea, coffee,
cereals, spices, oils & fats. Their analysis and analysis of common preservatives
used in processed foods. Permissible limits of Preservatives.

UNIT IV

   Total quality management, objectives of production planning and concept of total
   quality Management (TQM); Good manufacturing practices, seven principles of HACCP
   & codex in food and its implication in food industries; Quality control methods of –
   raw materials, manufacturing process & finished products.

9. **Food Safety** – Role of voluntary agencies & legal aspects of consumer
   protection. National & International food laws – PFA, FDA, BIS, AGMARK, FSSAI,
   2011, Essential Commodity Act, Export (quality & inspection act, Consumer
   protection act), Nutritional labeling requirements of foods

**REFERENCE BOOKS**-

1. Environmental and Applied microbiology Unit III Microbiology of food - 2013 -
   Open University ; Nugegoda.
   Publishers.
   Delhi, India: CBS Publishers.
BMF 5051 – ENVIRONMENTAL MICROBIOLOGY

Max. Marks: 25 Marks
Theory: 22 Marks
Internal Assessment: 3 Marks
Time: 3 Hrs

1. Isolation of amylase producing bacteria from soil.
2. Isolation of protease producing bacteria from soil.
3. Isolation of lipase producing bacteria from soil.
4. Isolation of antibiotic producer from soil.
5. Isolation of cellulase producer from soil.
6. Isolation of phosphate solublizing microbes from soil.
7. Demonstration of rhizosphere effect.
8. Determination of TS, TDS, TSS in industrial effluent.
10. Determination of BOD of industrial effluent.
11. Determination of COD of industrial effluent.
12. Isolation of ammonifying bacteria.

BMF 5052 – FOOD ANALYSIS AND QUALITY CONTROL

Max. Marks: 25 Marks
Theory: 22 Marks
Internal Assessment: 3 Marks
Time: 3 Hrs

1. Detection of different type of sugars in fruit juices by TLC
2. Testing of given canned product
3. Shelf life testing of packaged product by HVP method
4. Proximate analysis of Butter
5. Determination of Fructose by Roe’s Resorcinol Method.
6. Colorimetric determination of Crude Protein (Kjeldahl Nitrogen).
10. Determination of Fat by Majonnier method.
11. Determination of preservatives in milk.
12. Determination of adulterants in milk, oils & Fats, spices, Tea and Coffee
13. Estimation of Vitamin C spectrophotometrically
14. To prepare a chart of specifications for different Food products as specified by BIS
15. Determine the Critical Control Points for production line of Milk, Fruits & Vegetables and Meat industry as per HACCP system.

B.Sc. PART III
(MICROBIAL AND FOOD TECHNOLOGY)
THIRD YEAR EXAMINATION
SIXTH SEMESTER

BMF 6001: ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY RIGHTS
MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: To educate the students about the concept of Entrepreneurship, Qualities of an entrepreneur, Formulation, market potential and Funding assistance for the projects. The paper also focuses on different intellectual property rights including patents, copyright, industrial designs, trademarks, plant varieties and trade secrets.

UNIT I

Entrepreneurship
Concept of entrepreneurship, Entrepreneurship characteristics, Entrepreneurship motivation and barrier, Principles of entrepreneurial development, Qualities of an entrepreneur, Functions and types of entrepreneur.

Economics
Demand-supply-pricing, Business ethics, Industrial laws, Women entrepreneurs – Role, problems and development.

UNIT II

Project Management
Formulation, Identification and selection based on size, Technological assessment, Project cost and market potential and marketing concepts.

Project Appraisals
Technical reports and feasibility reports with commercial viability, Break-even analysis, Depreciation, Sources of funding.

UNIT III

Introduction to Intellectual Property
Introduction to Intellectual Property: Intellectual property and IPR, patent, copyright and related Rights, trademarks, trade secret, Industrial design and Rights, Geographical Indications

Importance of IPR
UNIT IV

Grant of Patent

Patent filing and Infringement
An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

REFERENCE BOOKS:

B.Sc. PART III
(MICROBIAL AND FOOD TECHNOLOGY)
THIRD YEAR EXAMINATION
SIXTH SEMESTER

BMF 6002: FOOD ENGINEERING

MAX. MARKS: 75 MARKS
THEORY: 67 MARKS
INTERNAL ASSESSMENT: 8 MARKS
TIME: 3 HRS

Instructions for the examiner: The Question Paper will have four sections. Examiner will set a total of nine questions comprising two questions from each unit, and one compulsory question of short answer type covering the whole syllabus. Students will attempt one question from each unit and the compulsory question. All questions may carry equal marks, unless specified.

Objectives: To educate students in different aspects of food engineering and their applications in food processing, it also deals with concepts of heat and mass transfer and food processing equipments.

UNIT I

1. **Units and Dimensions**: Concept of Unit operation, Mass Energy balance, Dimensions and Units, Unit Conversion, Dimensional Analysis

2. **Psychrometric chart**: Dry and wet bulb temperature, HUMIDITY & RELATIVE HUMIDITY, adiabatic saturation temperature, Dew point, Information about psychrometric chart

3. **Refrigeration**: Reverse Carnot’s cycle, Pressure enthalpy chart, temperature entropy chart, vapor compression refrigeration system, equipment’s C.O.P., Refrigeration load calculation, Application of refrigeration in food processing operations

UNIT II

4. **Freezing**: Principles and methods, Different types of Freezers, Industrial problems associated of frozen storage food products
5. **Introduction to Heat Transfer:** Heat Transfer, modes of heat transfer, conduction through a flat wall, conduction through hollow cylinder, convective heat transfer, radiation heat transfer

6. **Heat transfer Equipments and Design:** Heat Transfer equipments, parallel and counter current flow heat exchangers, Logarithmic mean temperature difference, heat transfer coefficient, heat exchanger design (preliminary), concept of black body, Emissivity and Absorptivity

**UNIT III**

7. **Flow of fluids:** Types of fluids and fluid flows, viscosity, Bernoulie’s equation and its application for measurement of flow rate Different types of pumps (Reciprocating, rotary and centrifugal pumps).

8. **Evaporation:** Mechanisms of vaporization, Boiling Point elevation, Different types of evaporators, Evaporation of heat sensitive materials

9. **Size Reduction:** Principles of size reduction, methods of size reduction.

10. **Mixing:** Theory of mixing, mixing of liquids & solids, types of mixers, power calculation in mixing. Homogenization

11. **Separation processes:** Principles and methods of gas absorption, Distillation, Extraction and washing, Filtration, sedimentation, sieving, centrifugation

12. **Membrane Separation Processes:** Separation by Sieving, Screen effectiveness; Theory of filtration, Reverse Osmosis, Nano filtration and Ultra filtration

**REFERENCE BOOKS –**


**PRACTICAL**

B.Sc. PART III

(MICROBIAL AND FOOD TECHNOLOGY)

THIRD YEAR EXAMINATION

SEMESTER VI

**BMF 6051 – ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY RIGHTS**

**MAX. MARKS:** 25 MARKS  
**THEORY:** 22 MARKS  
**INTERNAL ASSESSMENT:** 3 MARKS  
**TIME:** 3 HRS

Visit to Industry/ Educational Institution/ Research Organization / Regulatory or promotional institutions etc. and submission of written Report and its presentation.
1. Measurement of rupture angle and angle of intergranular friction of grains and powders
2. Particle size analysis and energy requirement in comminution
3. Homogenization of milk and measurement of size of fat globules before and after homogenization
4. Coefficient of viscosity of water, milk, juices etc. by flow through a capillary tube
5. Surface tension of water by Jaeger’s method
6. Mechanical equivalent of heat by calendar and Borne’s apparatus
7. Design of piping and piping network
8. Design of conveyor system for solids
9. Drying rate curves for different wet materials
10. Study of different types of heat exchangers
11. Food Plant Design and preparation of layout
12. To solve problems based on Psychometric chart
14. To study different components of refrigeration system.
15. To study thermal properties of foods.