



**SIES College of Arts, Science and Commerce (Autonomous)  
Sion (West), Mumbai – 400022.**

**Department of Biochemistry-Food Technology and Nutraceuticals**

**PROPOSED SYLLABUS FOR**

**Master of Science (MSc)-  
Food Technology & Nutraceuticals**

**To be implemented from June 2023**

**For the academic year 2023-24**

**(NEP-2020 implementation)**

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## **PREAMBLE**

**CREDIT STRUCTURE FOR MSc PART I**

Semester	Major		Research Methodology	On Job training of field project	Research project	Credit /Semester	Degree/Cumulative credit
	Mandatory	Electives					
I	7 + 7= 14 C	4 C	4 C	-	-	22 C	PG Diploma 44
II	7 + 7= 14 C	4 C	-	4 C	-	22 C	
Total (I+II)	28 C	8 C	4 C	4 C	-	44 C	

**Summary of courses offered by the department.**

Sr. no	Course	Title	MARKS		
			Theory	Practical	Total marks
<b>Semester 1</b>					
1	Core 1	Food Science	60 + 40 (4 Credits)	50 (2 Credits)	150
2	Core 2	Biochemistry & Human Physiology	60 + 40 (4 Credits)	50 (2 Credits)	150
3	Core 3	Food Quality	50 (2 Credits)		50
5	DSE	Food Safety Hygiene & Sanitation	75 (3 Credits)	25 (1 Credit)	100
4	RM	Research Methodology	75 (3 Credits)	<b>Research proposal – 25 M</b> (1 Credit)	150
<b>Total</b>			<b>17 credits</b>	<b>5 credits</b>	<b>600</b>
<b>Semester 2</b>					
1	Core 1	Food Technology	60 + 40 (4 Credits)	50 (2 Credits)	150
2	Core 2	Functional Foods and Nutraceuticals	60 + 40 (4 Credits)	50 (2 Credits)	150
3	Core 3	Food Standards and Quality Control	50 (2 Credits)		150
4	DSE	Food Analysis; Entrepreneurship	60 + 40 (3 Credits)	<b>25</b> (1 Credits) <b>Dissertation</b>	150
5	RM	OJT/INTERNSHIP (mandatory in case of exit after one year)	<b>04 credits</b>		
<b>Total</b>			<b>17 credits</b>	<b>5 credits</b>	<b>600</b>

## Summary of Course-wise Units

### SEMESTER I

COURSE CODE	UNIT	TOPICS	CREDITS	L/ WEEK
SIPSFTN11	<b>FOOD SCIENCE</b>		<b>04</b>	<b>04</b>
	<b>I</b>	Food Science I		
	<b>II</b>	Food Science II		
	<b>III</b>	Food Science III		
	<b>IV</b>	Class Assignment and Presentation		
SIPSFTN12	<b>BIOCHEMISTRY AND HUMAN PHYSIOLOGY</b>		<b>04</b>	<b>04</b>
	<b>I</b>	Nutritionally important biomolecules I		
	<b>II</b>	Nutritionally important biomolecules-II		
	<b>III</b>	Human Physiology-I		
	<b>IV</b>	Human Physiology-II		
SIPSFTN13	<b>FOOD QUALITY</b>		<b>02</b>	
	<b>I</b>	Introduction to Food quality		
	<b>II</b>	Defects and texture affecting quality		
	<b>III</b>	Quality of raw materials		
SIPSFTN1-DSE	<b>FOOD SAFETY, HYGIENE &amp; SANITATION</b>		<b>03</b>	<b>03</b>
	<b>I</b>	Introduction to Food Microbes		
	<b>II</b>	Microbial spoilage		
	<b>III</b>	Basic Sanitation		
	<b>IV</b>	Effluent Treatment		
	<b>RESEARCH METHODOLOGY</b>		<b>03</b>	<b>03</b>
	<b>I</b>	Research Method, design and ethics		
	<b>II</b>	Sampling techniques		
	<b>III</b>	Statistics in Research		
	<b>IV</b>	Statistical tests and computer applications indata analysis		
<b>Practicals</b>				
SIPSFTNP11	<b>Food Science Practical</b>		<b>02</b>	<b>04</b>
SIPSFTNP12	<b>Food Biochemistry Practical</b>		<b>02</b>	<b>04</b>
SIPSFTNP1-DSE	<b>Food safety, hygiene &amp; Sanitation</b>		<b>01</b>	<b>01</b>
	<b>Research methodology (NPD proposal)</b>		<b>01</b>	<b>01</b>

**SEMESTER II**

<b>COURSECODE</b>	<b>UNIT</b>	<b>TOPICS</b>	<b>CREDITS</b>	<b>L/ WEEK</b>
<b>SIPSFTN21</b>	<b>FOOD TECHNOLOGY</b>		<b>04</b>	<b>04</b>
	<b>I</b>	Food processing & preservation I		
	<b>II</b>	Food processing & preservation II		
	<b>III</b>	Processing of miscellaneous food		
	<b>IV</b>	Fortification and Enrichment		
<b>SIPSFTN22</b>	<b>FUNCTIONAL FOODS &amp; NUTRACEUTICALS</b>		<b>04</b>	<b>04</b>
	<b>I</b>	Functional foods & Nutraceuticals-I		
	<b>II</b>	Functional foods & Nutraceuticals-II		
	<b>III</b>	Functional foods and Nutraceuticals in health management:		
	<b>IV</b>	Extraction and Isolation of natural bioactive compounds		
<b>SIPSFTN23</b>	<b>FOOD STANDARDS &amp; QUALITY CONTROL</b>		<b>02</b>	
	<b>I</b>	Food laws and standards- Global/International bodies		
	<b>II</b>	Food regulations in India.		
	<b>III</b>	Quality Management		
<b>SIPSFTN2-DSE</b>	<b>FOOD ANALYSIS AND ENTREPRENEURSHIP</b>		<b>03</b>	<b>03</b>
	<b>I</b>	Food Analysis-I		
	<b>II</b>	Food Analysis-II		
	<b>III</b>	Entrepreneurial Skills		
<b>Practicals</b>				
<b>SIPSFTNP21</b>	<b>Food Technology practical</b>		<b>02</b>	<b>04</b>
<b>SIPSFTNP22</b>	<b>Functional foods &amp; nutraceuticals</b>		<b>02</b>	<b>04</b>
<b>SIPSFTNP2-DSE</b>	<b>Food Analysis</b>		<b>01</b>	<b>01</b>

## MSc. Theory Syllabus

<b>Course</b>	<b>Core Paper I - Food science</b>	Lectures:60
	<i>Course Outcome: On completing the course, the learner should be able to</i>	
	<ol style="list-style-type: none"> <li>1. Learn the structure, composition, and functional properties of each individual component of food system.</li> <li>2. Understand the importance of other food elements such as spices and plantation crops.</li> <li>3. Recognize the various processed foods and beverages along with the awareness of food adulteration.</li> <li>4. Explore the role and function of different food additives used in processing of food.</li> </ol>	
	<b>Food Science I</b>	
	<b>1.1 Cereals:</b> Structure & Composition; Flours, cooking cereals, breakfast cereals; Gluten, classes of batters and doughs, leavening process	
	<b>1.2 Pulses:</b> Structure and composition, anti-nutritional factors in pulses; Texturized vegetable proteins, soy isolates, beverages. <b>Fruits &amp; Vegetables:</b> Structure & Composition; Physiochemical changes during harvesting, post harvesting, ripening, cooking, storage; Organically grown fruits & vegetables	
Unit 1	<b>1.3 Milk &amp; Milk products:</b> Structure & Composition; Milk components as Food ingredients (Lipid phase, protein micelles, milk salt system, whey proteins, lactose); Use of milk in formulated foods; Effect on food processing on nutrients <b>1.4 Fats &amp; Oils:</b> Structure & composition; Functional properties of fat; Fat substitutes/ mimetics	15
	<b>Food Science II</b>	
	<b>2.1 Meat, fish, and poultry:</b> Structure and functions of muscles; Conversion of muscle to meat (Rigor mortis, ageing, tenderizing); Natural and Induced post-mortem biochemical changes (cold shortening, thaw rigor, electrical stimulation); Fish – composition, spoilage; Eggs- structure and composition, cooking changes, effect of added ingredients on coagulation	
Unit 2	<b>2.2 Sugars, Sweeteners and Confections:</b> Role of sugars in food systems; Types of sugars and sugar syrups; Sugar based and cocoa-based confections. <b>2.3 Functional Properties of Food:</b> Maillard reaction, dextrinization, Gelatinization, Caramelization, retrogradation, denaturation, coagulation, gluten formation.	15



### Food Science-III

Unit 3	<p><b>3.1</b> Spices Production and processing scenario of spice, flavor &amp; plantation crops, and its scope and manufacture of value-added products, specific examples of pepper, cardamom, ginger, turmeric, vanilla, garlic, Dill seed Fern seed nutmeg mint marjoram, Rosemary, saffron, sage.</p> <p><b>3.2</b> Soft Drinks-Types, Specification for beverage water, Alkalinity reduction, filtration of water, water softening. Sweeteners used in soft drinks and their properties, non-nutritive sweeteners, Natural colorants used in soft drinks, Synthetic colorants used in soft drink Acidulants used in soft drink. Clouding agents for soft drinks, Flavoring agents used in soft drink, Carbon dioxide and carbonation for soft drink.</p> <p><b>3.3</b> Food adulteration</p> <p><b>3.4</b> Food additives: Types, General principles, and regulation in their use. Additives: emulsifiers, firming agents, humectants and propellants, Anti browning and anticaking agents, antioxidants, raising and glazing agents, stabilizers, thickening and gelling agents, foaming and antifoaming agents.</p> <p>Class Assignment / Tutorials / Quiz</p>	15
Unit 4	<ol style="list-style-type: none"><li>1. Examples of Food additives</li><li>2. Antinutritional factors in Soybean &amp; overcoming it; Texturized vegetable proteins, soy isolates &amp; beverages.</li><li>3. Value added products in markets using spices</li></ol>	15

## Course I Practicals

Course	Food Science	Credits
	<p><i>Course Outcome:</i> On completing the course, the learner should be able to</p> <ol style="list-style-type: none"><li><i>1. comprehend the methods used to convert metric values and estimate the nutritional value of dietary components.</i></li><li><i>2. Understand and recall the science involved in the preparation of food. Appreciate the use of substances such as starch, gluten, sugar, fats, and oils in food.</i></li><li><i>3. Understand how the addition of various acidulants affects the chemistry of milk protein coagulation.</i></li></ol> <ol style="list-style-type: none"><li>Nutritive value</li><li>Metric Conversions</li><li>Determination of gluten</li><li>Ice crystallization (Ice-cream)</li><li>Sugar Cookery</li><li>Gelatinization of starch</li><li>Starches as thickening agents</li><li>Emulsions</li><li>Smoke point, Effect of temperature on fat, coating, binding, texture, flavor, mouthfeel</li><li>Effect of acids (citric acid, lactic acid, and acetic acid) on coagulation of milk proteins</li></ol>	2

## MSc. Theory Syllabus

	<b>Core Paper II - Biochemistry &amp; Human Physiology</b>	Lectures:60	
	<p><b>Course Outcome:</b> <i>On completing the course, the learner should be able to</i></p> <ol style="list-style-type: none"> <li>1. Know the macro- and micronutrients the human body needs for development and growth.</li> <li>2. Grasp the principles of nutrition and solve numericals based on these concepts.</li> <li>3. Understand and recall human physiology in normal and disease condition.</li> </ol>		
	<p><b>Nutritionally significant biomolecules I:</b></p> <p><b>1.1 Biochemical constituents of food</b> – Digestion and Absorption of carbohydrates, proteins, lipids. Nutritional significance of Vitamins and water.</p> <p><b>1.2 Basic concepts of nutrition:</b> Basics of energy balance - Basal Metabolic Rate (BMR), Body Mass Index (BMI) and Specific Dynamic Action (SDA/ thermic effect)</p>		
Unit 1	<p>Recommended dietary allowance, acceptable dietary intake, Nutrient reference values (NRVs), Nitrogen balance, protein efficiency ratio, net protein utilization, PDCASS.</p> <p><b>1.3 Carbohydrates:</b> Classification, Structure and Properties of monosaccharides and disaccharides (maltose, lactose, sucrose); Properties and significance of Polysaccharides- Starch, Cellulose, Glycogen, Dextrin, Chitin, Pectin, agar, Hyaluronic acid, Chondroitin sulphate</p>	15	
Unit 2	<p><b>Nutritionally significant biomolecules-II</b></p> <p><b>2.1 Proteins:</b> classification of amino acids and their properties (isoelectric pH, solubility profile); Peptides; classification of proteins; structure (primary, secondary, tertiary, and quaternary); Denaturation of proteins.</p> <p><b>2.2 Lipids:</b> Classification- Simple, compound, and Derived; Properties of Fatty acids, Triacylglycerols, Cholesterol.</p> <p><b>2.3 Enzymes:</b> General properties of enzymes, Classification of enzymes- IUB/EC classification (up to I digit), Active site of enzyme, mechanism of action: lock and key, induced fit, transition state theory. Cofactors, Coenzymes (role of vitamins), Prosthetic groups, Apoenzyme and Holoenzyme, Enzyme kinetics Factors affecting enzyme-catalyzed reactions. Derivation of Michaelis-Menten equation, Km, Lineweaver Burk plot, Catalytic efficiency- turn over number, Enzyme activity: Katal, IU Specific activity of enzyme. Enzyme inhibition: Competitive (allopurinol and Sulphonamides, Methotrexate) and Noncompetitive (Iodoacetate and Diisopropyl fluorophosphate).</p>		15

	<b>Human Physiology I</b>	
	<b>3.1</b> Basic human tissues. Introduction to human skeleton. Structure of bone and cartilage.	
	<b>3.2 Heart</b> Its structure and circulation of blood. Cardiac cycle Information about hypertension & ischemic heart disease.	
Unit 3	<b>3.3 Respiratory system</b> Respiratory organs-nose, sinuses, larynx, trachea, bronchi lung brief structure and functions. Mechanism of respiration, factors affecting efficacy of respiration. Various lung volumes and capacities. Common diseases- TB, asthma, bronchitis, cough, pneumonia sinusitis.	15
	<b>3.4 Gastro - intestinal system</b> Oral cavity, tonsils, pharynx, esophagus, stomach small and large intestine - brief structure and functions. Liver, gall bladder, pancreas structure and functions. Common disorders- Dental caries, vomiting, diarrhea, constipation. Hyperacidity, diabetes.	
	<b>Human Physiology II</b>	
	<b>4.1 Excretory system:</b> Structure and function of organs of urinary system (in brief). Mechanism of urine formation Common diseases-urinary tract infection and renal stones.	
Unit 4	<b>4.2 Structure and function of Skin; Regulation of body temperature</b> Common disorders – acne, dandruff, and burns.	15
	<b>4.3 Nervous system:</b> Classification of nervous system Structure and functions of different parts of brain, spinal cord, and reflex action. Eye - Structure and mechanism of vision Common problems - conjunctivitis, cataract. Ear - Structure and mechanism of hearing Common problems -deafness, vertigo, motion sickness	

### Core Paper II Practicals

Course	Core Paper II - Biochemistry & Human Physiology	Credits
	<p><i>Course Outcome: On completing the course, the learner should be able to</i></p> <ol style="list-style-type: none"> <li>1. Determine the amount of ash in a food sample.</li> <li>2. Acquire skills in food sampling</li> <li>3. Determine the amount of carbohydrates and protein are present in food samples.</li> <li>4. Check the Sol-gel characteristics.</li> <li>5. Identify micrographs of organ sections.</li> </ol>	
	<ol style="list-style-type: none"> <li>1. Concepts of food sampling</li> <li>2. Determination of ash content</li> <li>3. Determination of Mineral content (Ca, P and Fe)</li> <li>4. Qualitative analysis of proteins (Biuret, precipitation)</li> <li>5. Qualitative analysis carbohydrates (Molish, Benedict's/Fehling's, Seliwanoff, Osazone)</li> <li>6. lipids: solvent extraction and weight determination</li> <li>7. Determination of moisture content by Hot air method/Karl Fischer method.</li> <li>8. Quantitative estimation of reducing sugars by DNSA method.</li> <li>9. Quantification of proteins by Folin Ciocalteau method.</li> <li>10. Lipid Analysis (Acid value, saponification and peroxide).</li> <li>11. Study of Sol-gel properties of different starch samples.</li> <li>12. Study of organs in different sections</li> </ol>	2

## MSc. Theory Syllabus

<b>Course</b>	<b>Core Paper III - Food Quality</b>	<b>Lectures:30</b>
	<p><b>Course Outcome:</b> On completing the course, the learner should be able to</p> <ol style="list-style-type: none"> <li>1. <i>Comprehend the significance of food quality and the factors affecting it.</i></li> <li>2. <i>Inter – relate various parameters describing the quality of food such as color, shape, size, texture, consistency, and flavor.</i></li> <li>3. <i>Apply the knowledge of analytical techniques and instruments in food quality detection.</i></li> <li>4. <i>Discern the processes involved in ensuring and recording the quality of food at industry level.</i></li> </ol> <p><b>Introduction to Food quality:</b> its role in industry definition of quality, quality control, factors affecting quality control. Quality attributes, dominant attributes, hidden attributes.</p>	
Unit 1	<p>Color-role of color in quality spectra, different types of color measuring instruments. Viscosity- types of fluids, different viscometers to measure viscosity. Consistency- Methods used to measure consistency of product Difference between viscosity and consistency. Size and shape- Its role, method to find shape and size of food and food products</p> <p><b>Defects:</b> classification, genetic- physiological defects- structural, off color, character, Entomological defects: holes, scars, lesions, off coloring, curled leaves,</p>	12
Unit 2	<p>Pathological defects Mechanical defects, Extraneous or foreign material defects.</p> <p>Measurement of defects: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting, Internal defects.</p> <p><b>Texture-</b> Classification, definition, and role of firmness, yielding quality, juiciness, chewiness, fibrousness, grittiness, mealiness, stickiness.</p>	10
Unit 3	<p><b>Quality of raw materials:</b> Physical, Chemical, and microbial quality. Quality of products during processing &amp; after processing color, taste, texture, flavor, appearance.</p> <p>Factors influencing the Food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging, and storage conditions of finished products. Recording and reporting of quality.</p>	8

**MSc. Theory Syllabus (DSE)**

**Course**                      **Core Paper IV - Food Safety, Hygiene & Sanitation**                      **Lectures: 45**

**Course Outcome:** *On completing the course, the learner should be able to*

1. *Categorize different kinds of microbes into subcategories and connecting them to food.*
2. *Recognize the obvious food product spoilages.*
3. *Implement the fundamental sanitation practices to sustain cleanliness in the food processing industry.*

**Introduction to Food Microbes**

Unit 1                      **1.1** Study of microorganisms in food: *Lactobacillus, S. aureus, Bacillus subtilis, E. coli, Salmonella, shigella, Clostridium,* Molds: *Aspergillus niger, Penicillium, Rhizopus, Yeast and Candida*                      15

**1.2** Microbial sources, microbial growth analysis, factors affecting growth of microorganisms: Intrinsic, Extrinsic

**Microbial spoilage**

Unit 2                      **2.1** Microbial spoilage and its effect on food; Spoilage of different kinds of food- cereals, pulses, fruits and vegetables, meat, fish, egg, poultry and their processed products, milk and milk products, canned foods, and beverages.                      15

**2.2** Food borne diseases, intoxication, infection, and microbial toxins.

**2.3** Class I & Class II Preservatives

**2.4** Hurdle Technology

**Basic Sanitation**

Unit 3                      **3.1** Principles of Food Hygiene, hygiene in urban and rural areas with respect to food preparations. Food handling habits and personal hygiene. Water supply systems and water purification, chlorination.                      15

**3.2** Types of Soil (Food residues on equipment surfaces) and its properties. Cleaning procedures, types of cleaning agents and their properties. Acid and alkaline cleaners. Physical

sanitizing agents' example Hot water, Steam and UV light. Sanitation facilities and procedures in food plant operations.

CIP system. Cleaning premises and surroundings.

**3.3** Common Pests in food services rodents, insects, birds, house flies, cockroaches, ants, and their control. Sanitation regulations, phytosanitary requirements. Hygiene and sanitation of preparation, storage, and retail shops. Plant and equipment design, requirements for ease in maintenance of hygiene and sanitation Study of food sanitation check lists

Unit 4	<b>Effluent Treatment</b> Kinds of filters Disinfection methods Water softening methods Treatment of domestic water supplies and industrial effluent treatment.	15
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## Practicals

<b>Course</b>	<b>DSE - Food Safety, Hygiene &amp; Sanitation</b>	<b>Credits</b>
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**Course Outcome:** *On completing the course, the learner should be able to*

1. *Understand the basics of microbiological analysis, which include culture media preparation, microorganism separation, preservation of culture media, and spoilage detection.*
2. *Assess the effectiveness of disinfectants and sanitizers.*
3. *Evaluate the BOD, COD, and microbiological content of industrial effluents for quality and safety.*
4. *Assess the milk and water's microbiological safety in terms of the presence of coliforms and live organisms.*
1. Preparation of culture media for cultivation of bacteria molds and yeasts.
2. Different methods of maintenance and preservation of cultures of microorganisms.
3. Different methods of isolation of microorganisms.
4. Bacteriological analysis of foods, yeast, and mold count in food samples
5. Study the factors affecting food spoilage – pH, sugar, temperature, moisture.
6. Microbial load of palm/ fingers, nose secretions of workers TPC/E.coli / vibrio- continue.
7. Testing of sanitizers, disinfectants for antimicrobial activity
8. BOD & COD of water
9. Study of microorganisms from effluent.
10. Microbial analysis of water and milk-Total count, Viable count, MPN Coliform and MBRT.
11. Biochemical tests for characterization of bacteria (IMVIC)

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## MSc. Theory Syllabus

<b>Course</b>	<b>Research Methodology</b>	Lectures:45
	<p><i><b>Course Outcome:</b> On completing the course, the learner should be able to</i></p> <ol style="list-style-type: none"> <li>1. Compare and contrast the various sampling techniques and realize their importance in research.</li> <li>2. Employ statistical methods for analysis and interpretation of biological data.</li> <li>3. Analyze and interpret the demographic &amp; diagnostic data using statistical tools and tests.</li> </ol> <p><b>Research Method, design and ethics</b></p> <p><b>1.1</b> An introduction to research methodology: -Definition, Objectives of research</p> <p><b>1.2</b> Types of research a) Descriptive vs. Analytical b) Applied vs. Fundamental c) Quantitative vs. qualitative d) Conceptual vs. Empirical Other types: a) Cross sectional vs. longitudinal b) Field setting or laboratory c) Clinical or diagnostic d) Exploratory Research e) Historical research.</p> <p><b>1.3</b> Research approach: Quantitative and qualitative approach Ethics in research; Literature review; Formulation of hypothesis</p> <p><b>1.4</b> Research designs: a) Need for a research design, features of a good design b) Types of research designs- Explorative/ descriptive/ experimental/ Survey/ Case Study</p> <p><b>Sampling techniques</b></p> <p><b>2.1</b> Sampling techniques a) Sample Design-Criteria of selecting a sampling procedure b) Characteristics of a good sampling design. c) Types of sample designs: non-probability sampling, Probability sampling.</p> <p><b>2.2</b> Determination of sample size for different types of research</p> <p><b>2.3</b> Measurement and scaling techniques</p> <p><b>Role of statistics in research</b></p> <ol style="list-style-type: none"> <li>a) Measures of central tendency: Mean, Median, Mode</li> <li>b) Measures of dispersion: Range, Interquartile range, Variance and Standard Deviation</li> <li>c) Normal distribution and normal curve</li> <li>d) Testing of Statistical Hypothesis</li> <li>e) Type I and Type II errors</li> <li>f) Guidelines for selecting an appropriate test.</li> </ol> <p><b>Statistical tests and Computer Applications in data analysis-</b></p> <p>Parametric test of difference- T-test, ANOVA b) Parametric tests of association- Pearson's correlation coefficient c) Nonparametric tests of difference- Chi-square d) Regression Analysis</p> <p>Computer applications in data analysis: Introduction to SPSS</p>	09
Unit 1		09
	<p><b>Unit 2</b></p> <p><b>2.1</b> Sampling techniques a) Sample Design-Criteria of selecting a sampling procedure b) Characteristics of a good sampling design. c) Types of sample designs: non-probability sampling, Probability sampling.</p> <p><b>2.2</b> Determination of sample size for different types of research</p> <p><b>2.3</b> Measurement and scaling techniques</p>	06
Unit 2		06
	<p><b>Unit 3</b></p> <ol style="list-style-type: none"> <li>a) Measures of central tendency: Mean, Median, Mode</li> <li>b) Measures of dispersion: Range, Interquartile range, Variance and Standard Deviation</li> <li>c) Normal distribution and normal curve</li> <li>d) Testing of Statistical Hypothesis</li> <li>e) Type I and Type II errors</li> <li>f) Guidelines for selecting an appropriate test.</li> </ol>	15
Unit 3		15
	<p><b>Unit 4</b></p> <p><b>Statistical tests and Computer Applications in data analysis-</b></p> <p>Parametric test of difference- T-test, ANOVA b) Parametric tests of association- Pearson's correlation coefficient c) Nonparametric tests of difference- Chi-square d) Regression Analysis</p> <p>Computer applications in data analysis: Introduction to SPSS</p>	15
Unit 4		15

**-RM: Course VI: Research Methodology Practical; 1 Credit: 15 hours**

New Product Development: Research Proposal writing and presentation.

## MSc. Syllabus Theory – Semester II

<b>Course</b>	<b>Core Paper I: Food Technology</b>	Lectures: 60
	<p><b>Course Outcome:</b> <i>On completing the course, the learner should be able to</i></p> <ol style="list-style-type: none"> <li>1. <i>Understand the steps involved in various high and low temperature processing techniques.</i></li> <li>2. <i>Familiarize with intricate technologies of spice processing and mechanism of flavor and aroma perception.</i></li> <li>3. <i>Differentiate among food fortification, food enrichment and food supplements.</i></li> </ol>	
	<p><b>Food Processing &amp; Preservation I</b></p> <p><b>1.1</b> Techniques of food preservation: High Temperature - Evaporation, Drying &amp; dehydration, Pasteurization, Canning and bottling, Retort processing and Smoking. Low temperature - Refrigeration, Chilling, Freezing. Non-thermal methods - radiations, controlled atmosphere storage, enzymes and bacteriocins.</p> <p><b>1.2</b> Food processing techniques: Baking, Frying, Roasting, Blanching</p> <p><b>1.3</b> Processing of Foods of plant origin: Processing of Cereals and pulses - Different types of processing methods used in case of cereals and pulses-conventional and modern methods, Processing operations such as milling, pearling, par boiling. Extruded, puffed and fermented cereal-based products, Indian traditional products. Malting.</p> <p><b>1.4</b> Processing of fruits and vegetables: Post harvest handling, storage, control of ripening, Introduction to fruit and vegetable products, different types of products, dehydration techniques, canning, processed fruits and vegetables - pulps, jams, jellies, marmalades and other products like fruit juice and fruit bars.</p> <p><b>1.5</b> Bakery - Different types of bakery products, manufacturing process of bread, biscuits, and others</p>	
Unit 1		15

## **Food Processing & Preservation II**

Unit 2	<p><b>2.1</b> Fermentation process in traditional food, commonly available fermented foods: sauerkraut, yoghurt, cheese, miso, tempeh, idli, dosa.</p> <p><b>2.2</b> Dairy technology: Milk processing by filtration, clarification, standardization, homogenization and pasteurization, cream separating techniques and chilling techniques. Types of milk and milk products- cream, butter, spray dried powder, casein, lactose, whey, ice cream, fermented dairy products, technology and applications with examples of Yoghurt, Acidophilous milk and value-added products (baby foods, weaning foods, therapeutic foods)</p> <p><b>2.3</b> Poultry, meat and fish processing - sources, process and products. (Chicken Sausages, Salami, Smoked Meat, Fish Fingers)</p> <p><b>Processing of miscellaneous food (oil, sugar &amp; confectionary, beverages, spices)</b></p> <p><b>3.1</b> Sugar and Confectioneries - Types of sugars and different products of sugar industry, sugar processing - chocolate and confectionary manufacturing.</p> <p><b>3.2</b> Beverages and spices technology - Chemistry and production technology of coffee, tea and cocoa cultivation, harvesting, management and manufacture, value added products: Spice industry - cultivation, processing, and manufacture of value-added products, specific examples of pepper, cardamom, ginger, turmeric, vanilla, garlic.</p> <p><b>3.3</b> Flavours a) Molecular mechanism of flavour perception (sweet, bitter, salty, sour, umami, kokumi, pungent, cooling and astringent) b) Flavours from vegetables, fruits, spices, fats and oils, milk, and meat products</p> <p>Pigments a) Pigments in Animal and Plant tissues (Haeme compounds, Chlorophyll, Carotenoids, Anthocyanins, Betalins) b) Synthetic Food Colours (toxicity and regulatory aspects)</p>	15
Unit 3		15

Unit 4	<b>4.1 Fortification and enrichment:</b> Definition, criteria of foodselection, methods of fortification, Indian and International scenario	
	<b>4.2 Processing of some specific foods</b>	15
	4.2.1 Processing of fruit juices, butter, margarine, cheese, marmalades, jams, value added products, processed meat, egg products, fish meal, etc.	
	4.2.2. Processing of barley, oats, rye, soybean, and its products	

## Practicals

Course

### Core Paper I - Food Technology

Credits

**Course Outcome:** On completing the course, the learner should be able to

1. Prepare various fruit products with added value, such as juices, sauces, jams, ketchups, jellies, and marmalades.
2. Process a variety of dairy products, including fermented drinks, cheese, butter, and paneer.
3. Produce baked goods, cookies, and crackers made from processed cereal.
4. Comprehend sugar cooking procedures through the production of candy.

1. Wine preparation.
2. Preparation of syrups, squashes, jams, jellies, fruit bars, ketchups, and sauces.
3. Lab scale preparation of fermented milk products (yogurt, cheese)
4. Manufacture of margarine & butter.
5. Preparation of cookies & biscuits.
6. Preparation of Chocolates and candies.

2

**\*Visits to Food industry is recommended**

## MSc. Syllabus Theory - Semester II

Course

### Core Paper II - Functional Foods & Nutraceuticals

Lectures:  
60

*Course Outcome: On completing the course, the learner should be able to*

1. Describe the various origins of nutraceuticals and functional foods.
2. Go over the advantages of health and resources for general wellbeing.
3. Analyze the manner in which ingredients in nutraceuticals are extracted.

#### Functional foods & Nutraceuticals-I

**1.1** Introduction; Nutraceutical Industry: Scope of the industry, Indian and global scenario. Classification of nutraceuticals based on source and chemical nature.

**1.2** Nutraceuticals of plant origin: Plant secondary metabolites- Terpenoids, Phenolics, Alkaloids, phytoestrogens, Pigments, Organo Sulphur compounds.

**1.3** Sources and health benefits of nutraceuticals:

Glucans, ascorbic acid, quercetin, kaempferol, rutin,  $\beta$ -carotene, allicin, lycopene, limonene,  $\alpha$ -tocopherol, zeaxanthin, caffeine, Olive oil, green tea

**1.4** Minerals – Ca, P, Cu, I, Zn, Se, F, Mg, Mn

#### Functional foods and Nutraceuticals-II

**2.1** Nutraceuticals of animal origin: collagen chitin, chitosan, glucosamine, chondroitin sulphate, conjugated linoleic acid, eicosapentenoic acid, docosahexaenoic acid, choline, lecithin.

**2.2** Microbial and algal nutraceuticals: Concept of prebiotics, probiotics and Synbiotics. Prebiotics: Non-digestible

Unit 1 carbohydrates- Dietary fibers, functional oligosaccharides, Resistant starch, and gums.

Probiotic microorganisms- Features and health benefits.

Probiotics in various foods: Dairy-based, fermented, and non-fermented foods. Quality assurance of probiotics and safety

Algae as source of omega-3 fatty acids, antioxidants, and minerals. kelp and spirulina

Unit 2

15

15

	<b>3.1 Functional foods and Nutraceuticals in health management:</b> Diabetes, management of Cancer, Cognitive decline, Liver & kidney disorders, Osteoporosis, Pediatrics, Geriatrics, Sports, Pregnancy and Lactation	
Unit 3	<b>3.2</b> Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity, and stress. <b>3.3</b> Concepts of standardization- Pharmacopeial standards. screening of phytochemicals <b>Extraction and isolation of natural bioactive compounds</b>	15
Unit 4	<b>2.1</b> Plant secondary metabolites: Properties of Alkaloids, phenols, Terpenoids, Glycosides. <b>2.2</b> Extraction and purification: Pre-extraction preparation, Isolation and purification: Traditional methods- maceration, Soxhlet extraction, decoction, infusion, percolation, sonication.	15



**2.3 Modern methods:** Microwave-assisted, ultrasound assisted, supercritical fluid extraction, accelerated solvent extraction.

**Class Assignments**

1. Collagen, gelatin, and Bioactive peptides
2. Polyunsaturated fatty acids
3. Health benefits of bioactive compounds/nutraceutical ingredients
4. Effect of food processing technology on bioactive components of nutraceuticals and functional foods

**Practicals**

<b>Course</b>	<b>Core Paper II - Functional Foods &amp; Nutraceuticals</b>	<b>Credits</b>
	<p><i>Course Outcome: On completing the course, the learner should be able to</i></p> <ol style="list-style-type: none"> <li>1. Extract different plant constituents</li> <li>2. Employ various methods and techniques for extraction of natural products from their sources</li> <li>3. Apply the knowledge of analytical techniques in estimation of natural compounds</li> <li>4. Conduct market research for several nutraceuticals and functional food products.</li> <li>5. Create certificate of analysis for a food product                             <ol style="list-style-type: none"> <li>1. Chemical profiling of plant samples and extracts.</li> <li>2. Extraction and characterization (UV/VIS, chromatography) of phytoconstituents:</li> <li>3. Extraction and characterization of alkaloids (Caffeine/Catechins).</li> <li>4. Extraction of Pigments (Lycopene, Curcumin, Carotenoids).</li> <li>5. Determination of caffeine and tannin content in coffee and tea.</li> <li>6. Study of functional foods and nutraceuticals already in market</li> <li>7. Preparation of certificate of analysis of nutraceutical raw material – turmeric and curcumin</li> </ol> </li> </ol>	<b>2</b>

## MSc. Syllabus Theory - Semester II

Lectures:30

## Course Core Paper III - Food Standards &amp; Quality Control

**Course Outcome:** On completing the course, the learner should be able to  
 1. Demonstrate awareness of Indian & International Food laws and regulatory authorities.

2. Understand Indian Food Safety Standards linked with each individual food product and special categories.

3. Analyze the various tools employed in the quality management system (QMS) of food industry.

4. Prepare a HACCP work plan for a food processing unit with significance to identifying the critical control point (CCP), fixing critical control limits (CCLs) and monitoring procedure.

**Food laws and standards- Global/International bodies**

**1.1** Understanding the food regulatory cycle.

Introduction to Global regulatory authorities for the food Industry

Unit 1 **1.2** Codex Alimentarius Commission (CAC): Introduction, standards, codex of practice, guidelines, and recommendations, applying codex standards, Codex India, core functions of National Codex Contact Point, National Codex Committee of India. 9

**Food Regulations in India:**

**2.1** History of food regulations in India. Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Meat Food Products Order (1973), Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

**2.2** FSSAI – Role of FSSAI - Food Safety and Standards Act, 2006 (FSS) and Regulations: Food Safety and Standards (Food Products Standards and Food Additives) Regulation, 2011. Food Safety and Standards (Packaging and Labelling) Regulation, 2011. 12

Unit 2 **2.3** Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, Functional Food and Novel Food) Regulations, 2016. Food Safety and Standards (Organic Food) Regulation, 2017. Food Safety and Standards (Fortification of Food) Regulation, 2018. Food Safety and Standards (Packaging) Regulation, 2018.

Standard weights and measures – legal metrology

**2.4** Voluntary National Standards: BIS and AGMARK

**Quality Management**

**3.1** Quality inspection, quality control, quality management and quality assurance. Total quality management

**3.2** Good manufacturing practices; Good agricultural practices  
 Good laboratory practices ; Quality management systems (QMS)  
 Quality Circles, SQC., ISO System.

**3.3** Quality Management in the Food Industry: Concept of Total Quality Management–Quality Management Systems

Unit 3	(QMS):ISO9001Food Safety Management Systems (FSMS): ISO 22000; General Principles of -GHP and GMP. Other food safety practices: Good Agriculture Practices, Good Retail Practices, Good Transport Practices, GDP and Nutrition Labelling, Traceability studies. <b>3.5 Hazard Analysis Critical Control Point (HACCP):</b> History, structure, pre- requites and principles, HACCP applications, HACCP based SOPs. Risk analysis: Introduction to risk analysis, Risk management, assessment and communication	9
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**MSc. Syllabus Theory - Semester II****Course****DSE - Food analysis and Entrepreneurship**

Lectures:45

**Course Outcome:** On completing the course, the learner should be able to

1. Understand the principle of working of various separation and analytical techniques. Apply this knowledge in separation, purification, identification and analysing food samples for quality and safety.

2. Create a strategy for determining the shelf life of a food product.

3. Comprehend diverse approaches for sensory evaluation. Analyse, evaluate and document the sensory characteristics of food samples.

4. Develop marketing and entrepreneurial skills.

**Food Analysis-I**

**1.1** Principle and applications of electrophoresis, Capillary and zone electrophoresis, PAGE, SDS-PAGE, Agarose.

**1.2** Basic concepts, principles, and applications: paper chromatography, thin layer chromatography, ion exchange chromatography, affinity chromatography and gel exclusion chromatography. High pressure liquid chromatography, gas liquid chromatography - principle, instrumentation, and applications. Column chromatography as a separation technique.

**1.3** Modern methods: Microwave-assisted, ultrasound assisted, supercritical fluid extraction, accelerated solvent extraction.

**Food Analysis-II**

**2.1 Study of Rheological properties and Principles of instruments used.**

Viscosity - Brookfield Viscometer, Texture Analyzer and Universal Testing Machine. Study of pH and its Importance in Food Technology. Study of Water Activity and its measurement. Polarimetry and measurement of color.

**2.2 Shelf-life study (ASLT) - Stability and Shelf-Life Studies- Definitions -Designing a shelf-life study, selecting characteristics to be studied in shelf-life studies -Types of Shelf-Life Studies- Simple, Comparative, accelerated shelf-life studies, Spiking of samples -Shelf-life study of a developed product.**

**2.3 Sensory Evaluation**

Importance of Sensory Evaluation, Physiological Bases of Sensory Evaluation, Sensory Characteristics of Food, Sensory Panels, Environment for Sensory Evaluation, Sensory Evaluation methods for quality of products. Correlation of sensory and instrumental analysis. Score cards & rating scales.

Unit 1

15

Unit 2

15

Unit 3	<p><b>Entrepreneurial Skill</b> -Definition and meaning of entrepreneurship -Types, Classification,and trends of Entrepreneurial ventures in foods and nutrition - Qualities and skills of an entrepreneur -Resources required for a business - Project formulation, Government and non-government opportunities for funds and resources. – Franchising opportunities</p> <p><b>Marketing skills</b>- Concepts of marketing -Channels of distribution -Market Researchand Marketing strategies -Market segmentation, targeting and positioning -Novel and innovative product /service development - Brand development and promotion</p>	15
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## Practicals

<b>Course</b>	<b>DSE – Food Analysis &amp; Entrepreneurship</b>	<b>Credit</b>
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**Course Outcome:** *On completing the course, the learner should be able to*

1. *Gain practical experience with chromatographic methods such thin layer, paper, and liquid chromatography. Apply this knowledge in separation, purification, identification and analysing food samples for quality and safety.*

2. *Capable of carrying out analytical tasks utilizing spectrophotometric methods.*

3. *Demonstrate awareness of the accelerated shelf life (ASLM) study methodology used to compare various processed items.*

4. *Comprehend and use diverse approaches for sensory evaluation. Analyse, evaluate and document the sensory characteristics of food samples.*

1. Sensory Evaluation
2. Shelf-Life Study
3. The identification of sugars in fruit juice using TLC
4. Separation of amino acids by two-dimensional paper chromatography
5. Molecular weight determination using sephadox-gel.
6. Estimation of phytic acid using spectrophotometer
7. Instrumentation Workshop / Visit

**1**

**Course V: OJT/Internship: 4 Credits**

## Recommended Reference Books

Sr.no.	Book Tittles / Research Papers
1	Vaclavik, V. A., Christian, E. W., & Campbell, T. (2008). Essentials of food science(Vol. 42). New York: Springer.
2	Smith, J., & Hong-Shum, L. (2011). Food additives data book. John Wiley & Sons
3	Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
4	Subbulakshmi, G., & Udipi, S. A. (2017). Food processing and preservation. NewAge International
5	Potter, N. N., & Hotchkiss, J. H. (2012). Food science. Springer Science & BusinessMedia
6	Srilakshmi, B. (2003). Food science. New Age International.
7	Introduction to Biochemistry – Rafi M.D
8	Introduction to Functional foods & Nutraceuticals – Rekha Sharma
9	Fundamental of Water Supply & Sanitary Engineering – Rangwala S.C
10	Guide to Improving food Hygiene – Ed Gaston & Tiffney
11	Functional foods & Nutraceuticals – Chukwuebuka Egbuna, Genevieve Dable – Tupas
12	Food Hygiene & Sanitation – S. Roday
13	Food Microbiology – W.C Frazier & D.C Westhoff
14	Safety of Foods – H.D. Graham
15	Quality Control for Food Industry – Krammer & Twigg
16	Quality Control in Food Industry - S.N Herchodgrfer
17	Advances in Food Research – Academic Press. Vol I
18	Practical Food Microbiology – Harry H. Weiser, J. Mountney & W.W Gord (Technical) 2 <sup>nd</sup> Edition
19	Sylvia Escott-Stump, Janice L. Raymond, Marie V. Krause (2012) Nutrition in Pregnancy and Lactation, Infancy, Nutrition in Adolescence, Adult Years, Aging
20	Eschleman, M. M. (1984). Introductory nutrition and diet therapy. Lippincott.
21	The Psychology of Food Choice (2006). United Kingdom: CABI.
22	Stanbury, Whitaker & Hall (2017) Principles of Fermentation Technology
23	Sylvia Escott-Stump, Janice L. Raymond, Marie V. Krause (2012) Nutrition in Pregnancy and Lactation, Infancy, Nutrition in Adolescence, Adult Years, Aging
24	Eschleman, M. M. (1984). Introductory nutrition and diet therapy. Lippincott.
25	Keith Wilson & John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology
26	Nielsen, S. S. (2017). Food analysis laboratory manual. Springer.
27	Shelf-Life Evaluation of Foods. (2012). United Kingdom: Springer US.
28	Food Packaging and Shelf Life: A Practical Guide. (2009). Ukraine: Taylor &Francis.
29	Taxmann Entrepreneurship Development
30	<a href="https://pubmed.ncbi.nlm.nih.gov/12671662/">https://pubmed.ncbi.nlm.nih.gov/12671662/</a> DOI: 10.1038/nrg1047
31	<a href="https://www.hindawi.com/journals/jnme/2014/202759/">https://www.hindawi.com/journals/jnme/2014/202759/</a> DOI: <a href="https://doi.org/10.1155/2014/202759">https://doi.org/10.1155/2014/202759</a>
32	<a href="https://pubmed.ncbi.nlm.nih.gov/19248861/">https://pubmed.ncbi.nlm.nih.gov/19248861/</a> DOI: 10.1016/j.jada.2008.11.02410.
33	<a href="https://pubmed.ncbi.nlm.nih.gov/27286972/">https://pubmed.ncbi.nlm.nih.gov/27286972/</a> DOI: 10.1159/00044634712.
34	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3191675/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3191675/</a> DOI: 10.5001/omj.2011.21

- 35 FAO Food Database <https://www.fao.org/faostat/en/>
- 36 WHO food database <https://www.who.int/teams/nutrition-and-food-safety/databases>
- 37 USDA food database <https://fdc.nal.usda.gov/>
- 38 Food Informatics and Its Challenges and Opportunities – A Review  
[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3042148](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3042148)
- 39 <https://www.mdpi.com/2304-8158/10/11/2889> <https://doi.org/10.3390/foods10112889>
- 40 <https://www.sciencedirect.com/science/article/pii/S102194981830173X>  
<https://doi.org/10.1016/j.jfda.2018.12.002>
- 41 <https://www.iso.org/iso-9001-quality-management.html>
- 42 <https://www.fssc.com/>
- 43 <https://www.fooddocs.com/post/food-safety-audit>
- 44 <https://pubmed.ncbi.nlm.nih.gov/21625170/> DOI: 10.1159/000327772
- 45 <https://pubmed.ncbi.nlm.nih.gov/16195369/> DOI: 10.1096/fj.05-3911rev
- 46 Essentials of Food & Nutrition – M.S. Swaminathan



**PATTERN OF EXAMINATION:** Semester Pattern

**SCHEME OF EXAMINATION**

- A) THEORY**
- B) PRACTICAL**

**EVALUATION SYSTEM**

**1. Standard of passing**

To pass each paper students are required to obtain a minimum of 40% marks in each internal (40 marks) and Semester end exam (60 marks).

**2. Assessment of Project / Industrial visit /study tour /Internship/Workshop**

**Report**

- The Industrial visit/study tour/on-job training/workshop report must be submitted by the prescribed date.
- The Industrial visit/study tour/ on-job training report and its presentation shall be evaluated by the coordinator of the course and concerned faculty.

### 3 Grade point for Theory/Practical/ Experiential learning

**Table –I: for 100/50 Marks Theory or Practical**

<b>Letter Grades and their equivalent Grade point</b>			
<b>Percentage of marks</b>	<b>Grade Point</b>	<b>Grade</b>	<b>Performance</b>
80.00 and above	10	O	Outstanding
70-79.99	9	A <sup>+</sup>	Excellent
60-69.99	8	A	Very Good
55-59.99	7	B <sup>+</sup>	Good
50-54.99	6	B	Above Average
45-49.99	5	C	Average
40-44.99	4	D	Pass
Less than 40	0	F	Fail

#### **Calculation of GPA and CGPA**

- Grade Point Average (GPA) =  $\frac{\Sigma (\text{course credits in passed courses} \times \text{earned grade points})}{\Sigma (\text{Course credits in registered courses})}$
- Cumulative Grade Point Average =  $\frac{\Sigma (\text{course credits in passed courses} \times \text{earned grade points}) \text{ of all Sem.}}{(\text{CGPA}) \quad \Sigma (\text{Course credits in registered courses}) \text{ of all Semesters}}$

#### **GPA and overall Grade**

<b>Grade Point</b>	<b>Grade</b>	<b>Description of Performance</b>
0-3.99	F	Fail
4.0 to 4.99	D	Unsatisfactory
5.0 to 5.99	C	Fair
6.0 to 6.99	B	Satisfactory
7.0 to 7.99	B <sup>+</sup>	Good
8.0 to 8.99	A	Very Good
9.0 to 9.99	A <sup>+</sup>	Excellent
10.00	O	Outstanding

- Ist Class with distinction: GPA > 7.0 and above [Text Wrapping Break]Ist Class: GPA > 6.0 and < 7.0
- IInd Class: GPA > 5.0 and < 6.0
- Pass Class: GPA > 4.0 and < 5.0
- Fail: GPA < 4.0

**Ordinances for grace marks and condonation:**

General Ordinances prescribed by the University of Mumbai (Item No. 4.101, dated 25/05/2011) and which are concurrent with the rules and guidelines of professional statutory bodies at the All-India level such AICTE, MCI, Bar Council, CCIM, CCIH, NCTE, UGC etc. are adopted.

**Table II: Symbols in the marksheet**

<b>Symbols in the marksheet</b>	<b>Description</b>
F	Head of failure
---	Not applicable
Ab	Absent
@	0.5043
#	0.229
\$	Carried forward grade of the Head