

# **KHALSA COLLEGE AMRITSAR**

**-An Autonomous College**

**Affiliated to Guru Nanak Dev University, Amritsar.**

**Session: 2017-18**

**Syllabus : M.Sc. Food Science & Technology**

**Post-Graduate Department of Food Science & Technology**

## M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER –I - IV

### **ORDINANCES FOR MASTER OF FOOD SCIENCE & TECHNOLOGY 2 YEAR DEGREE PROGRAMME IN THE DEPARTMENT OF FOOD SCIENCE & TECHNOLOGY**

#### **1. Duration:**

The duration of the course shall be four semester after graduation.

#### **2. Eligibility**

A candidate who has passed any one of the following examination is eligible for admission in M.Sc. Food Science & Technology Course

1. Bachelor in Food Science & Technology (Honours)
2. B.Sc. Agriculture (Honours)
3. B.Sc. Food Science & Quality Control
4. B.Sc. Medical
5. B.Sc. Non-Medical
5. B.Sc. Clinical Nutrition
6. B.Sc. Home Science

With 50% marks or any equivalent examination recognized by UGC

#### **3. Scheme of Instructions-Examination**

For each examination, every student admitted to the courses under the semester system must be on the rolls of the institution, and shall send his/her admission form and fees for the examination through the Principal/Head of the Institution, accompanied by the following certificates.

- a) Of having attended at least 75% of the total number of lectures delivered in each theory and practical course separately. Deficiency in lectures may be condoned as per college/university rules. If in particular semester, a student falls short of attendance in a maximum of two courses, he/she would be permitted to appear in the semester examination of the papers in which he/she fulfill the attendance requirements. The course/s in which the student does not fulfill the minimum attendance requirements, he/she shall not be permitted to appear in the semester examination of such course/s, and shall be declared as having failed in such course/s. A student who is falling short of attendance in maximum two courses, he/she shall be required to attend the minimum number of lectures which were falling short, during next year when the course/s is/are offered.
- b) Of having good moral character
- c) The syllabi, courses of reading and regulations for the courses shall be notified by the college/university from time to time, and shall be deemed to constitute an integral part of ordinances. Course evaluation under the semester system of evaluation shall be done on marks basis. If a course has both the theory and practical components, the student will be required to pass both the components, separately. However, if the student fails in theory, but is passing in practical examination of that course, he/she will be required to clear the theory paper only, and vice-versa.
- d) Carry on system for semester examinations.

#### **Courses having four semester duration:**

- a. There shall be no condition for promoting a student from first semester to second semester.
- b. However, the student shall be promoted to third semester only if he/she has passed at least 50% courses/papers of the first two semesters.
- c. There shall be no condition for promoting a student from third semester to fourth semester
- d. In case a student fails to pass all the courses/papers within a period of four semesters (Two Years), he/she shall be given four consecutive semesters (Two Year) more to pass.

**Note 1:** No special chance or exemption shall be allowed beyond what is stated in the above Ordinances.

**Note 2:** Failing students shall appear in the examination in the regular semester examinations next year i.e. reappear of examination for an odd semester shall be conducted along with the next odd semester, and even semester along with the next even semester and there shall be no special supplementary examinations.

**Note 3:** If 50% of the courses/papers required to pass involve a fraction, the fraction of the course/paper will be treated as a full course. For example, if in a year there are 13 courses in two semesters, the candidate will be required to pass minimum of 7 courses/papers.

e) The pass marks for a course (paper) shall be 40% at Post Graduate Degree level. Pass marks in aggregate for all the courses shall be 40%. Re-evaluation shall be allowed as per college/university rules.

If a candidate obtains less than 40% marks in aggregate at the end of final semester/year of his/her course but is pass in all individual papers, the result of such a candidate shall be declared as 'fail', and he/she shall be required to improve his/her score in one or more papers in any of the semesters/year so as to obtain a minimum of 40% marks in aggregate to pass the examination excluding internal assessment. The internal assessment of 20% of total marks in a subject as mentioned in the course structure shall be based on the overall performance in studies as per college rules.

All the examinations shall be conducted by a board of examiners to be appointed by the recommendation of Board of Studies.

Except for languages the instructions for the paper setters would be as under:

i) Question paper should strictly be according to the syllabus.

ii) The language should be simple and straight.

iii) Not more than one question should be based on one topic.

iv) The question should cover the whole syllabus and questions should be evenly distributed.

v) The examiner will set eight questions covering the whole syllabus out of which a student will be required to attempt five questions.

vi) The answer books will be evaluated by the examiners in each paper. In case external examiner is not available. The practical examination shall be held and shall be valid even if the external examiner fails to turn up after confirming appointment. A substitute may then be appointed by chairman board of studies/Principal/Head of the department. Each question paper for practical examination shall be set with the mutual consent of Internal and external examiner on the spot.

viii) There will be practical in plant training of 4 weeks after 2nd semester in the summer vacations.

ix) Master's seminar will be evaluated by an internal examiners deputed by Head of the department / Chairman board of Studies

f) The medium of instructions shall be English.

g) Grace marks shall be given at the rate of one percent of the total aggregate marks of the University examination in each semester. A candidate may avail grace marks either in aggregate or in one or more papers as may be to his advantage. Grace marks shall, however, be given for passing, for earning reappear or for earning higher division and not for passing the examination with distinction.

h) Maximum time will be allowed to pass a course is given below

Course duration	Maximum time to complete a degree
Two years	Four years

i) The candidate shall be treated to be failing in the course offered in the semester in which he has not sought admission/dropped the semester and such course/papers in which the candidate has failed shall be taken into account while deciding the promotion of the candidate in subsequent semesters as per the condition. The candidate shall be required to seek admission into the second semester examination as a regular candidate at the end of the prescribed duration of the course, but within the maximum time allowed to pass a course as given under para (h) of the ordinances, provided that he fulfills all other requirements under the prevailing ordinances. Regular students admitted to a course shall register/enroll themselves with the university/college in the very first semester of their admission and pay prescribed fee to the college/university. Direct admission to second semester is not allowed. The same rule shall apply to private and capacity enhancement programme students.

The above shall also apply to all such courses in which admission to a college as a prerequisite as a regular student.

The above provision is extended to all the Post Graduate Courses. This provision shall also be extended for subsequent semesters.

## 5. Assignments

In courses involving report/dissertation/thesis/case study/status report/training reports/term report or any other such assignment, the candidate shall be required to submit any such assignment, required in the partial fulfillment of the degree, by the 31<sup>th</sup> July of the last semester of the course, in which he/she is registered. The Principal/ Head of Department may, however, give an extension of one month after this date i.e. up to 31<sup>st</sup> August with fine as per college rules. In case the candidate fails to submit such an assignments at the end of this period of extension, he/she shall be awarded an 'Incomplete grade (I)' for this course and shall not be considered for any merit position/medal/award of the College/ university. Students getting 'I grade' shall have to seek admission to the next semester and shall have to pay fees and other funds as per the College/university rules. Assignments /dissertation/Thesis shall be evaluated by an examiner deputed by Head of department / Chairman board of Studies/Principal of the college.

#### **6. Discipline**

Each student shall be under the control and discipline of the concerned institution. In case of any misconduct on the part of a student, the institution shall have a power to take disciplinary action against the defaulter, to the extent of cancellation of admission of the defaulting student from the rolls of the institution.

#### **7. Result-Division-Degree**

The successful candidates shall be classified into the following divisions:

- a) **First Division with distinction**-Those who obtain 75% or more marks at the end of their course.
- b) **First Division**-Those who obtain 60% or more marks at the end of their course.
- c) **Second Division**- Those who obtain 50% or more marks, but less than 60% marks at the end of their course.
- d) **Third Division**- Those who obtain 40% or more marks, but less than 50% marks at the end of their course.

The successful candidate shall be awarded the degree in the subject of his/her study indicating the divisions obtained on the basis of the result of all the semester examinations. A student who does not complete the programme of study within the minimum duration of the course of his/her study, or fails in any course, shall not be eligible for any merit position/medal/award of the College/university.

# M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -I - IV

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			Theory	Practical	Internal	Total	
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1	MFT - 101	Principles of Food Processing & Preservation	50	30	20	100	01
2	MFT - 102	Food Microbiology	50	30	20	100	02
3	MFT - 103	Dairy Technology-I ( Fluid Milk Processing )	50	30	20	100	03
4	MFT - 104	Technology of Cereal Processing	50	30	20	100	04
5	MFT - 105	Technology of Fruits & Vegetable Processing	50	30	20	100	05
<b>SEMESTER-II</b>							
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7	MFT - 202	Dairy Technology-II (Milk Products Processing )	50	30	20	100	07
8	MFT - 203	Technology of Legumes & Oilseeds	50	30	20	100	08
9	MFT - 204	Technology of Egg & Poultry Processing	50	30	20	100	09
10	MFT - 205	Food Engineering-I	50	30	20	100	10
11	MFT - 206	In Plant Training	-	-	-	-	11
<b>SEMESTER-III</b>							
12	MFT - 301	Food Packaging Technology	50	30	20	100	12
13	MFT - 302	Food Engineering-II	50	30	20	100	13
14	MFT - 303	Technology of Fish & Meat Processing	50	30	20	100	14
15	MFT - 304	Applied Research Methodology	50	30	20	100	15
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17	MFT - 401	Food Quality Assurance & Management	50	30	20	100	17
18	MFT - 402	Industrial Microbiology & Fermented Foods	50	30	20	100	18
19	MFT - 403	Advances in Food Nutrition	50	30	20	100	19
20	MFT-404	Application of Enzymes in Food Industry	50	30	20	100	20
21	MFT - 405	M. Sc. Dissertation	-	-	-	100	21

## M.Sc. Food Science and Technology

### SEMESTER-I

Course Code	Course Title	Credits			Marks			
		Theory	Practical	Total Credits	Theory	Practical	Internal Assessment	Total
MFT 101	Principles of Food Processing and Preservation	3	4	7	50	30	20	100
MFT 102	Food Microbiology	3	4	7	50	30	20	100
MFT 103	Dairy Technology-I (Fluid Milk Processing)	3	4	7	50	30	20	100
MFT 104	Technology of Cereal Processing	3	4	7	50	30	20	100
MFT 105	Technology of fruits and vegetable processing	3	4	7	50	30	20	100
	Total	15	20	35	250	150	100	500

### SEMESTER-II

Course Code	Course Title	Credits			Total Marks			
		Theory	Practical	Total Credits	Theory	Practical	Internal Assessment	Total
MFT 201	Food Chemistry	3	4	7	50	30	20	100
MFT 202	Dairy Technology –II (Milk Products Processing)	3	4	7	50	30	20	100
MFT 203	Technology of Legumes & Oilseeds Processing	3	4	7	50	30	20	100
MFT 204	Technology of Egg & Poultry Processing	3	4	7	50	30	20	100
MFT 205	Food Engineering-I	3	4	7	50	30	20	100
	Total	15	20	35	250	150	100	500

**MFT – 206 In-plant Training of 4 weeks duration in Food Processing Industry after the completion of 2<sup>nd</sup> Semester. Satisfactory/Non-Satisfactory**

## M.Sc. Food Science and Technology

### SEMESTER-III

Course Code	Course Title	Credits			Marks			
		Theory	Practical	Total Credits	Theory	Practical	Internal Assessment	Total
MFT 301	Food Packaging Technology	3	4	7	50	30	20	100
MFT 302	Food Engineering-II	3	4	7	50	30	20	100
MFT 303	Technology Fish & Meat Processing	3	4	7	50	30	20	100
MFT 304	Applied Research Methodology	3	4	7	50	30	20	100
MFT 305	Master's Seminar	-	4	4	-	100	-	100
	Total	12	20	32	200	220	80	500

### SEMESTER-IV

Course Code	Course Title	Credits			Marks			
		Theory	Practical	Total Credits	Theory	Practical	Internal Assessment	Total
MFT 401	Food Quality Assurance & Management	3	4	7	50	30	20	100
MFT 402	Industrial microbiology and fermented foods	3	4	7	50	30	20	100
MFT 403	Advances in Food Nutrition	3	4	7	50	30	20	100
MFT 404	Application of Enzymes in Food Industry	3	4	7	50	30	20	100
MFT405	M.Sc. Dissertation	-	4	4	100	-	-	100
	Total	12	20	32	400	120	80	500

**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -I**

**(MFT-101 PRINCIPLES OF FOOD PROCESSING & PRESERVATION)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory:**

**UNIT-I**

Principles of Preservation methods, Microbial, Physical, and chemical preservation of foods.  
Food preservation by low-temp: Refrigeration, changes in food during refrigeration storage; freezing, types of freezer, freezing process, thawing, changes in Food during freezing; and freeze-drying.

**UNIT-II**

Preservation and processing methods by high temp: Blanching, canning, pasteurization, sterilization, extrusion cooking; Drying, Types of dryers, Dehydration effect in foods.  
Non-thermal preservation: Microwave processing, ionizing irradiation, membrane technology, Aseptic processing, Intermediate Moisture Foods: Principles, Characteristics, Advantages, and Problems in developing new IM foods.

**UNIT-III**

Recent methods in food preservation: Pulse electric field technology, Infrared, High Pressure, Ohmic heating, Hurdle technology.

**Practicals:**

- Determination of thermal inactivation time of enzymes.
- Adequacy of blanching
- Dehydration of foods.
- Preservation of food products by low temperature.
- Preservation of food products by concentration method.
- Use of chemicals in preservation of foods.
- Cut out examination of canned foods.
- Visit to a food processing plant.

**Suggested Readings**

Arsdel W.B., Copley, M.J. and Morgen, A.I. 1973. Food Dehydration, 2nd Edn. (2 vol. Set). AVI, Westport.  
Bender, A.E. 1978. Food Processing and Nutrition. Academic Press, London.  
Fellows, P. and Ellis H. 1990. Food Processing Technology: Principles and Practice, NY.  
Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport.

(Signature)



**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -I**

**(MFT-102 FOOD MICROBIOLOGY)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory:**

**UNIT-I**

Introduction, Bacteria, yeasts and molds important in foods, food viruses, extrinsic and intrinsic factors affecting growth of microorganisms in foods

*Growth and Destruction of Microorganisms:* Physical and chemical factors affecting the destruction of microorganisms, TDT, Z, F, D values.

**UNIT-II**

*Microorganism in Natural Products and Their Control:* Microbiology of milk and milk products, cereals and cereal products; meat and meat products, fruits and vegetables, fish or fish products: poultry and eggs; sugars and syrups, spices and salt, canned foods.

**UNIT-III**

Food infections, food intoxications, mycotoxins, non-bacterial food poisoning.

Food plant sanitation. Methods of detection of microorganisms in foods. Concept of HACCP

**Practicals:**

- To study the spoilage of microorganisms present in spoiled Bread, Dry Milk, Raw Milk, Condensed Milk, Jam, Butter, Cheese etc.
- The enumeration and identification of micro flora involved in spoilage through SPC and microscopic method.
- To study microbiological quality of raw milk, pasteurized milk and dry milk.
- To compare the percentage acidity of milk and curd.
- To check the quality of pasteurization by phosphate test.
- To determine to ascorbic acid content of given food material by 2, 6-dichlorophenol indophenol method.

**Suggested Readings:**

1. Banwart, G.J. 1989, Basic Good Microbiology. 2<sup>nd</sup> Edition. Van Nostrand Reinhold.
2. Frazier, W.C. and Westener, D.C., 1988. Food Microbiology. 4th edition. McGraw Hill Inc., New York.
3. Jay, J.M., 1986. Modern Food Microbiology 3rd Edition, Van Nostrand Reinhold.

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## M. Sc. FOOD SCIENCE &amp; TECHNOLOGY - SEMESTER -I

(MFT-103 DAIRY TECHNOLOGY-I (Fluid Milk Processing))

Time: 3 Hours

Max. Marks: 100  
 Theory Marks: 50  
 Practical Marks: 30  
 Internal assessment: 20

**Instructions for the Paper Setters:**

**Theory:** – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.

**Practical** – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.

**UNIT-I**

**Milk:** Present status of milk production and availability in India and Abroad, sources of milk, Definition, Composition of milk of various species, important characteristics of major constituents of milk viz. milk fat, milk proteins, lactose and minerals. Minor constituents of milk. Factors affecting the quality and quantity of milk produced by milk animals. Physical, chemical and Nutritive properties of milk.

**Market Milk :** Brief introduction to Standard milk, Toned milk, Double toned milk, Flavoured milk, Vitamin enriched milk, Reconstituted milk and recombined milk. Legal and ISI standards of milk. Adulterations of milk and its detection. Common preservatives used in milk and their detection. Collection, transportation and distribution of milk. Clean milk production.

**UNIT-II**

**Milk Processing :** Processes of straining, Filtration and clarification.

**Standardization :** Definition of standardization, purpose and uses of standardization process. Use of Pearson's square method to solve the standardization problems in dairy industry.

**Homogenization :** Definition, Effect of homogenization on milk. Uses of homogenization. Checking the effectiveness of homogenization.

**UNIT-III**

**Pasteurization :** Definition, purposes and objects of pasteurization – LTLT and HTST processes of pasteurization.

**Sterilization:** Definition, Method for manufacturing of sterilized flavoured milk. UHT process.

**Practicals:**

- Sampling equipment and sampling of milk. Different types of milk samples.
- Platform tests (Acidity, COB and Alcohol test).
- Organoleptic Tests: (Physical examination of milk).
- Determination of milk fat percentage by Gerber's method.
- Determination of specific gravity by lactometer.
- Determination of SNF percentage and TS percentage of milk with lactometer.
- Detection of common adulterants and preservatives of milk.
- Reporting on the suitability of milk for heat processing.
- Reporting on the quality of given sample of milk.
- Visit to milk processing plants.
- Visit to N.D.R.I Karnal.

**Suggested Readings:**

Outlines of Dairy Technology by Sukumar De, 1980, Oxford University Press, New Delhi.

Milk & Milk Products by Eckles, CH, Combs WB, Macy H, 1997, McGraw Hill Book, New Delhi

Principles of Dairy Processing by Warner JN, 1976, Wiley Science Publishers USA.

(Signature)

**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -I**

**(MFT-104 TECHNOLOGY OF CEREAL PROCESSING)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory:**

**UNIT-I**

General introduction to cereals, Structure and nutrient distribution in cereals.

Wheat: wheat types, milling of wheat, quality of flour and flour treatments, Technology of bread, biscuits, cakes, durum wheat, extruded products (pasta and noodles).

**UNIT-II**

Rice: Rice milling, milling machines, effect of different factors on milling yield and rice quality parboiling of rice and its nutritional advantages, Rice bran oil, Rice products- quick cooking rice, infant foods, puffed rice, rice flakes.

**UNIT-III**

Corn: wet milling and dry milling, corn flakes, corn starch and its hydrolyzed syrups.

Oats: Milling of Oat, Preparation of oat flakes, porridge (dalia) and oat meal.

**Practicals:**

- Milling of wheat, Physico–chemical testing of wheat and rice.
- Parboiling and evaluation of quality of parboiled rice.
- Evaluation of cooking quality of rice.
- Determination of gluten
- Preparation of chapattis
- Determination of crude fiber, ash, protein and fat
- Determination of FFA of wheat flour
- Baking of bread, cookies and cakes.
- Visit to wheat and rice processing plants.

**Suggested Readings**

Wheat Chemistry and Technology by Yashajahu Pomeranz & F.H. Websten

Oats Chemistry and Technology by F.H. Websten

Corn Chemistry and Technology by S.A. Watsan and P.E. Ramsat

Rice Chemistry and Technology by B.O. Juliano

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -I****(MFT-105 TECHNOLOGY OF FRUITS & VEGETABLE PROCESSING)****Time: 3 Hours****Max. Marks: 100****Theory Marks: 50****Practical Marks: 30****Internal assessment: 20****Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory****UNIT-I**

Post-harvest physiological and biochemical changes in fruits and vegetables; ripening of climacteric and non-climacteric fruits.

Principles and methods of fruits and vegetables preservation, Desirable characteristics of fruits & vegetables for processing. Preparing fruits & vegetables for processing, washing, sorting, grading, peeling, blanching, cutting, de-stoning and pitting. Canning & Bottling of fruits & vegetables products.

**UNIT-II**

Definition, Formulation, Preparation & FPO standards of Fruit juices , Method of juice extraction, Equipment, preservation and clarification. Squashes & Cordials, Fruit syrups, Nectar. Fruit juice concentrates. Jams, jellies & Marmalades. Fermented and non-fermented pickles, Tomato Juice, Tomato Puree, Paste, Chutney, Sauce, Soup & Ketchup. Preserves and candied products.

**UNIT-III**

Freezing: General Methods of Freezing of Fruits & Vegetables: their Packaging & Storage. Dehydration of Fruits & Vegetables.

**Practicals:**

- Preparation of fruit and vegetable juices.
- Concentration of fruit and vegetable juices
- Preparation of squashes, RTS
- Preparation of Jams, Jellies, Marmalades.
- Preserve & Candied Fruit
- Preparation of potato chips.
- Preparation of pickles
- Preparation of tomato puree, paste & ketchup.
- Dehydration and sun drying of fruits & vegetables.
- Visit to canning industry

**Suggested Readings**

Preservation of Fruits and Vegetables–Girdhari Lal, Siddhapa and Tondon, ICAR, New Delhi.

Hand Book of Analysis and Quality Control of Fruits & Vegetable Products–S. Ranganna

Tata McGraw Hill, New Delhi.

Commercial Vegetable Processing–Wood Roof & Lue.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II****(MFT-201 FOOD CHEMISTRY)****Time: 3 Hours****Max. Marks: 100  
Theory Marks: 50  
Practical Marks: 30  
Internal assessment: 20****Instructions for the Paper Setters:**

**Theory:** – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.

**Practical** – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.

**Theory:****UNIT-I**

Definition and importance; major food constituents and their physico-chemical properties; role of water in food. Water activity

Carbohydrates-chemical reactions, functional properties of sugars and polysaccharides in foods. Important carbohydrates and their applications in foods.

**UNIT-II**

Protein and amino acids: structure, classifications, sources, denaturation and functional properties of proteins.

Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties. Oxidative and hydrolytic rancidity, reversion, Tests to check purity of fats and oils.

**UNIT-III**

Vitamins and Minerals: Different types and their effect of processing on vitamins and minerals. Deficiency diseases.

**Practicals:**

- Preparation and standardization of solution.
- Moisture content by Drying method and Moisture meters
- Total ash, acid soluble and insoluble ash.
- Protein content by Biuret method/ Lowry's method and Kjeldhal method
- Estimation of reducing & non-reducing sugars, total sugars.
- Lipid estimation by Soxhlet method, Peroxide value and Free fatty acid.

**Suggested Readings**

Birch, G.G., Cameron, A.G. and Spencer, M. 1986. Food Science, 3rd Ed. Pergamon Press, New York.

Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.

Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi.

**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II**  
**(MFT-202 DAIRY TECHNOLOGY-II (Milk Products Processing))**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory:** – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.

**Practical** – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.

**Theory:**

**UNIT-I**

**Cream:** Different types of cream, composition, production methods. Factors affecting the richness of cream produced by cream separator. Care of cream separator. Selection of site for setting up creamery. Neutralization and ripening of cream.

**Butter:** Types of butter, composition. Preparation of butter. Defects of butter – their possible causes and remedies.

Factors affecting the churnability of cream. Churning theories.

**Cheese:** Classification of cheese. Preparation methods of cheddar cheese. Quality of milk for cheese making.

**UNIT-II**

**Condensed and evaporated milk:** Definition, composition & standards. Condensing operations.

**Dried milk products:** Introduction, objects of production, standards and composition.

Preparation of dried milk and milk powder by roller and spray drying methods. Packaging and storage. Malted milk powders and infant milk food.

**Ice Cream:** Different types of ice creams and their composition. Ingredients used and their role in processing. Manufacturing process. Defects in ice-cream, their possible causes and remedies.

**UNIT-III**

**Ghee :** Preparation of ghee from cream and from butter, advantages and disadvantages of both methods. Pre-stratification method of ghee preparation. Legal standards, Granularity in ghee.

**Khoa:** Manufacturing of khoa, Physico-chemical changes in milk on its conversion into khoa, shelf life and average composition of khoa.

**Paneer and Channa :** Manufacturing method of paneer, Legal standards and shelf life of paneer. Preparation of channa and its difference from that of paneer.

**Miscellaneous dairy products :** Brief introduction to Kulfi, Srikhand, Lassi and Rabri.

BIS and legal standards of milk and milk products.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II**

**(MFT-202 DAIRY TECHNOLOGY-II (Milk Products Processing))**

**Practicals:**

- Preparation of flavoured milk.
- Cream separation, neutralization and ripening.
- Preparation of Butter.
- Preparation of Khoa.
- Preparation of Paneer and Channa.
- Preparation of common varieties of ice-cream.
- Quality evaluation of milk and milk products.
- Visit to different milk plants to learn about milk condensing and drying operations.
- Visit N.D.R.I., Karnal.

**Suggested Readings**

Outlines of Dairy Technology by Sukumar De, 1980, Oxford University Press, UK  
Milk & Milk Products by Eckles Combs, Henery C, and Willes C, 1997, Tata McGraw Hill Publishers, USA.

Principles of Dairy Processing by Warner JN, 1976, Wiley Science Publishers, USA.

Technology of Indian Milk Products by Anya RP, Mathur BN, Chandan RC and Banerjee AK, 2002.. Dairy India Publ.

**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II**  
**(MFT-203 TECHNOLOGY OF LEGUMES AND OILSEEDS)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**THEORY:**

**UNIT-I**

Structure and composition of legumes. Dal milling and processing of pulses, cooking methods, utilization of legumes, anti-nutritional factors in legumes and methods of removal.

Soybean Processing, Soy products- Technology of soymilk, tofu, soy protein concentrate and isolates.

**UNIT-II**

Oilseeds– composition, oil extraction with expellers, solvent extraction processes, purification of crude oil and hydrogenation, interesterification and refining processes for oil.

**UNIT-III**

Nutritional importance of oils and fats. Quality assessment tests for fats and oils. Manufacture of margarine & mayonnaise.

**Practicals:**

- Preparation of soya milk/tofu.
- Experimental expeller processing and solvent extraction of oil seeds.
- Quality evaluation of oil extracted from oilseeds.
- Experimental Milling of Legumes.
- Separation and evaluation of starch and protein from different legumes.
- Cooking quality, textural evaluation and physico–chemical testing of legumes.
- Preparation of edible flours, protein concentrates and isolates.
- Determination of trypsin inhibitors.
- Visit to Legume & Oil seeds processing plants.

**Suggested Readings**

Chakrabarty MM. 2003. *Chemistry and Technology of Oils and Fats*. Prentice Hall

Hamilton RJ & Bhati A. 1980. *Fats and Oils - Chemistry and Technology*. App. Sci. Publ.

Kay DE. 1979. *Food Legumes*. Tropical Products Institute.

Mathews RH. 1989. *Legumes Chemistry, Technology and Human Nutrition*. Marcel Dekker.

Salunkhe DK.1992. *World Oilseeds: Chemistry, Technology and Utilization*. VNR.

Swern D. 1964. *Bailey's Industrial Oil and Fat Products*. Inter Sci. Publ.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II**  
**(MFT-204 TECHNOLOGY OF EGG & POULTRY PROCESSING)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory:**

**UNIT-I**

Eggs: Structure and composition of eggs. Functional properties of eggs. Nutritive value of eggs. Interior qualities - Evaluation, quality troubleshooters in eggs, Egg grading. Spoilage of eggs. Preservation of eggs. Handling, packaging, storage and transportation of eggs. Freezing of eggs. Dehydration of eggs - Egg powders, egg foams, factors influencing foaming.

**UNIT-II**

Poultry: Types, factors affecting quality, chemical composition and nutritive value of poultry meat. Slaughtering and dressing of poultry. Rigor mortis and Meat tenderization.

**UNIT-III**

Grading and packaging of poultry meat, storage, transportation of poultry meat. Preservation of poultry meat by different methods. Refrigeration of poultry meat, Waste Utilization of poultry industry by-products. Layout and design of poultry processing Industry.

**Practicals:**

- Determination of Egg components.
- Determination of proximate composition of eggs.
- Grading and quality evaluation of eggs.
- Effect of high temperature on coagulation time of egg contents.
- Preservation of eggs.
- Determination of egg density.
- Preparation of egg products, boiled, fried, poached, scrambled, omellette.
- Slaughtering and dressing of poultry.
- To make retail cuts of dressed chicken and calculating % yields.
- Preparation of chicken pickle
- Preparation of chicken patties.
- Visit to poultry processing industry

**Suggested Readings:**

Egg Science & Technology by Stadelman  
Poultry Products Technology by G.J. Mountney

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II**  
**(MFT-205 FOOD ENGINEERING-I)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory**

**UNIT-I: Basics of Food Engineering**

- **Units and Dimensions:** Fundamental and derived units, system of measurement, brief introduction to dimensions, Application of mathematical techniques in process calculation.
- **Material and Energy Balance Calculations:** General principles, process calculations and application in food processing operations.
- **Material Handling Equipments:** Introduction, Types of conveyors, Working operation, principle, and application in food industry.

**UNIT-II: Fluid Flow and Pumps:**

- **Fluid Flow:** Properties and classification of fluid, Concept of viscosity and its measurement-Capillary tube and rotational viscometer, Newtonian and non Newtonian fluids, Reynold's number, equation of continuity, Bernoulli's theorem, Poiseuille's equation, flow measuring devices-Pitot tube, Venturimeter, orifice meter, Rheology of foods and application of rheological models.
- **Pumps:** Liquid Transport system, Selection criteria of pipes for processing plants, types of pumps.

**UNIT-III Principles of Heat and Mass Transfer**

- **Heat Transfer:** Steady and unsteady heat transfer. Conductive heat transfer-Fourier's law, thermal conductivity, conduction through rectangular slab, hollow cylinder, spherical shell, composite rectangular wall (series), and composite cylinder. Convective heat transfer-convective heat transfer coefficient, free and forced convection, overall heat transfer coefficient. Types of Heat exchangers.
- **Mass Transfer:** Basic concepts of analogy between heat, mass and momentum transfer, Fick's Law of diffusion, interphase mass transfer, Convective mass transfer coefficient, Basic mass transfer equations for molecular diffusion in solids, liquids and gases
- **Psychrometry:** Properties of dry air, water vapor and water vapor mixture, psychrometric chart and its application

**Practicals:**

- Design calculations of of belt conveyor, bucket elevator and screw conveyor.
- Calculation of Reynold's Number.
- To calculate coefficient of discharge using venturimeter.
- To calculate coefficient of discharge using orificemeter.
- To check the performance of pump using given fluid.
- Study of psychrometrics-use and application.
- Determination of heat transfer coefficient in free and forced convection.
- Study of boiling point elevation.
- Determination of thermal conductivity of food materials.

**Suggested Readings:**

Earle RL. 1985. *Unit Operations in Food Processing*. Pergamon Press.  
 McCabe WL & and Smith JC. 1971. *Fundamental of Food Engineering*. AVI Publ.  
 Singh RP & Heldman DR. 2013. *Introduction to Food Engineering, 5<sup>th</sup> edition*.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -II**

**(MFT-206 IN PLANT TRAINING)**

**Time: 4 Weeks**

**In-plant Training of 4 weeks duration in Food Processing Industry after the completion of 2<sup>nd</sup> Semester.**

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**M. Sc. FOOD SCIENCE & TECHNOLOGY- SEMESTER -III**

**(MFT-301 FOOD PACKAGING TECHNOLOGY)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory**

**UNIT-I**

Definitions, objectives and functions of packaging and packaging materials. Packaging requirements and selection of packaging materials.

Types of packaging materials:

*Paper:* pulping, fibrillation and beating, types of papers and their testing methods.

*Glass:* composition, properties, types of closures, methods of bottle making.

*Metals:* Tinplate containers, tinning process, components of tinplate, tin free steel (TFS), types of cans, aluminum containers, lacquers.

*Plastics:* Types of plastic films, laminated plastic materials, co-extrusion, edible films, biodegradable plastics.

**UNIT-II**

Properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength; tear strength, their methods of testing and evaluation.

Barrier properties of packaging materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement.

**UNIT-III**

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

New trends in food packaging: Retortable pouch technology. Aseptic processing of food products. Packaging machinery: form fill and seal, thermoform, shrink wrap. Package standards and regulations.

## M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -III

### (MFT-301 FOOD PACKAGING TECHNOLOGY)

#### **Practicals:**

- Identification and testing of packaging materials.
- Determination of wax from wax paper.
- Testing of lacquered tin plate sheets.
- Measurement of tin coating weight by Clarke's method.
- To conduct ferricyanide paper test for porosity.
- Determination of equilibrium moisture content.
- Determination of water vapour transmission rate of packaging material.
- Testing the compression strength of the boxes.
- Packaging the food material in seal and shrink packaging machine and study its shelf life.
- Testing the strength of glass containers by thermal shock test.
- Testing the strength of filled pouches by drop tester.
- Testing the compression strength of boxes.

#### **Suggested Readings:**

Crosby NT. 1981. *Food Packaging: Aspects of Analysis and Migration Contaminants*. App. Sci. Publ.

Kadoya T. (Ed). 1990. *Food Packaging*. Academic Press.

Mahadeviah M & Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw Hill.

Palling SJ. (Ed). 1980. *Developments in Food Packaging*. App. Sci. Publ.

Painy FA. 1992. *A Handbook of Food Packaging*. Blackie Academic.

Sacharow S & Griffin RC. 1980. *Principles of Food Packaging*. AVI Publ.

Stanley S & Roger CG. 1970. *Food Packaging*. AVI Publ.

**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -III**

**(MFT-302 FOOD ENGINEERING-II)**

**Time: 3 Hours**

**Max. Marks: 100**

**Theory Marks: 50**

**Practical Marks: 30**

**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**UNIT-I: Basic Units Operations**

- **Filtration:** Theory, constant rate and constant pressure filtration, Equipments
- **Centrifugation:** Theory, Settling equations in centrifuge, Equipments
- **Membrane Separation:** Theory, Performance equation, Types of membrane separation units
- **Size Reduction:** Definition and requirements of size reduction, forces used in size reduction, equipments for size reduction. Critical speed in a tumbling mill. Modes of operation, energy requirements calculation for comminuting of solids.

**UNIT-II: Food Engineering operations-I**

- **Evaporation:** Parts of evaporator, single effect and multiple effect evaporator, different types of evaporators, steam economy, design of evaporator, thermal and mechanical vapour recompression system.
- **Distillation:** Vapor liquid equilibrium relations, Distillation methods, McCabe Thiele method.
- **Refrigeration:** Components of refrigeration system, refrigeration cycle and calculation of refrigeration load.

**Unit-III: Food Engineering operations-II**

- **Freezing:** Types of freezing systems, Calculation of freezing time by Plank's equation
- **Dehydration:** Theory of drying, free and bound, critical moisture content, equilibrium moisture content, drying rate curves, drying time prediction, types of driers

**Practicals:**

- Determination of freezing time by using Plank's equation.
- To calculate the refrigeration load in cold storage plant.
- Study of dehydration characteristics of food materials using tray drier.
- Study of distillation operation.
- To study working operation of hammer mill
- To study working operation of roller mill.
- To calculate the particle size of given flour sample using sieve analysis.
- To calculate specific cake resistance and filter medium resistance in a filtration process.
- To study working principle of rotary vacuum evaporator.

**Suggested Readings:**

Earle RL. 1985. *Unit Operations in Food Processing*. Pergamon Press.

McCabe WL & Smith JC. 1971. *Fundamental of Food Engineering*. AVI Publ.

Singh RP & Heldman DR. 2013. *Introduction to Food Engineering, 5<sup>th</sup> edition*.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY- SEMESTER -III**  
**(MFT-303 TECHNOLOGY OF FISH & MEAT PROCESSING)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory**

**UNIT-I**

*Meat:* Chemical composition and microscopic structure of meat. Postmortem biochemical changes. Physico-chemical properties of meat.

Slaughtering of animals- beef and pig. Packaging, Storage and Transportation of meat.

**UNIT-II**

Deboning of meat by mechanical methods. Meat tenderization and effects of processing on meat tenderization.

Meat Sausages and Restructured meat products. Intermediate moisture and dried products.

Meat plant sanitation and safety, Byproduct utilization. Inspection and grading of meat.

**UNIT-III**

*Fish:* Types of fish, composition, structure, post – mortem changes in fish. Handling, storage and transportation of fish. Preservation of fish: Curing, smoking, freezing and drying of fish, Comminuted Fish Products. Fish pastes and sauces. Fish oils, fish protein concentrates, fishmeal.

By products utilization of fish industry.

**Practicals:**

- To study the slaughtering of animals.
- To evaluate the meat quality.
- Preparation of Meat pickle and meat patties.
- Preparation of cured meat.
- To study the manufacturing of meat sausages.
- Shelf–life studies on processed meat products.
- To evaluate the quality of raw fish.
- To determine meat to bone ratio of fish meat.
- Dressing of fish and to calculate the dressing percentage of fish.
- Preparation of fish products.
- Dehydration and Freezing of fish.
- Visit to local slaughterhouse.

**Suggested Readings:**

Principles of Meat Science by Forrest et.al. 1975.

Developments in Meat Science by Lawrie–Vols. 1,2,3,4, 1998.

Processed Meats by Pearson (1996).

Fish Processing Technology by George M. Hall (1997).

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## M. Sc. FOOD SCIENCE &amp; TECHNOLOGY - SEMESTER -III

(MFT-304 APPLIED RESEARCH METHODOLOGY)

Time: 3 Hours

Max. Marks: 100

Theory Marks: 50

Practical Marks: 30

Internal assessment: 20

**Instructions for the Paper Setters:**

**Theory:** – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.

**Practical** – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.

**UNIT-I**

- **Introduction:** Types and objectives of research, research process, principle of research design, Principles of research design and methodology.
- **Planning and designing:** Choosing research topic, literature review, formulation a research problem, articulating hypothesis.
- **Sampling and analysis of data:** Random sampling, complex sampling, data collection, frequency distribution and its representation, Measurement of central tendency, dispersion, skewness and kurtosis.

**UNIT-II**

- **Data analysis:** correlation, regression analysis.
- **Testing of hypothesis:** Concept of probability, probability distribution, Normal, Poisson, Chi-square, t-test, z-test, F-test, level of significance, confidence intervals, testing of correlation coefficients.

**UNIT-III**

- ANOVA- One way and Two way ANOVA.
- **Statistical software:** Basics and application of statistical softwares.
- **Synopsis and Thesis Writing:** Synopsis and thesis writing Chronology. References writing methods, ethical consideration in research.
- Writing review paper and research papers.

**Practicals:**

Student will required to review literature on their respective given problem and submit the same for evaluation.

**Suggested Readings:**

- Kothari, C.R. (2004). Research Methodology: Methods and Techniques, New Age International Publishers, New Delhi.
- Arya, P.P. and Pal, Y. (2001). Research methodology in management: Theory and case studies, Deep and Deep publishers Pvt. Ltd., New Delhi.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -III**

**(MFT-305 MASTER'S SEMINAR)**

**Time: 3 Hours**

**Max. Marks: 100**

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -IV**  
**(MFT-401 FOOD QUALITY ASSURANCE & MANAGEMENT)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory:**

**UNIT-I**

Concept of quality: Objectives, importance and functions of quality control, Quality attributes- physical, chemical, and sensory Quality Attributes: their measurement and evaluation; Sensory and instrumental methods for testing quality.

**UNIT-II**

Methods of quality assessment of food materials fruits, vegetables, cereals, dairy products, meat, egg and processed products. Concept of HACCP & GMP

**UNIT-III**

Sampling procedures and plans; Food Safety and Standards Act, 2006; Various organizations dealing with inspection, certification and quality assurance (PFA, FPO, MMPO, MPO, AGMARK, BIS). Quality assurance, Total Quality Management; GHP; GLP. Food adulteration.

**Practicals:**

- Testing and evaluation of quality attributes of raw and processed foods.
- Objectives, importance and functions of quality control.
- Methods of quality assessment of food materials fruits, vegetables, cereals, dairy products, meat, egg and processed products.
- Sensory methods for measuring food quality.
- Analysis of products for FPO specifications.
- Qualitative and quantitative Determination of adulterants in food products.
- Determination of food additives and food constituents.
- Visit to Units with HACCP certification.

**Suggested Readings:**

Amerine MA, Pangborn RM & Rosslos EB. 1965. *Principles of Sensory Evaluation of Food*. Academic Press.  
 Early R.1995.*Guide to Quality Management Systems for Food Industries*. Blackie Academic.  
 Furia TE.1980. *Regulatory status of Direct Food Additives*. CRC Press.  
 Jellinek G. 1985. *Sensory Evaluation of Food - Theory and Practice*. Ellis Horwood.  
 Krammer A & Twigg BA.1973. *Quality Control in Food Industry*. Vol. I, II. AVI Publ.  
 Macrae R, Roloson R & Sadlu MJ. 1994. *Encyclopedia of Food Science & Technology & Nutrition*. Vol. XVI. Academic Press.  
 Piggot J.R. 1984. *Sensory Evaluation of Foods*. Elbview Applied Science.  
 Ranganna S. 2001. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd Ed. Tata-McGraw-Hill.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -IV**  
**(MFT-402 INDUSTRIAL MICROBIOLOGY & FERMENTED FOODS)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory**

**UNIT-I**

Introduction : History of fermentation processes

Fermentor Design : Fermentor parts and instrumentation.

**UNIT-II**

Downstream processing methods : Filtration , precipitation, centrifugation, cell disruption, Liquid extraction, drying & crystallisation.

Production of products: Potable and fuel alcohols, amino acids, organic acids, enzymes and vitamins, Antibiotics.

**UNIT-III**

Fermented milk products : Curd, yogurt, acidophilus milk, Bulgarian milk, butter milk, Kefir, Kumiss.

Legume based fermented foods: Soya sauce, miso, tempeh, idli.

Fermented vegetable products: Sauerkraut, cucumbers.

Fermented meat products: Meat sausage.

**Practicals:**

- To prepare the fermented food sauerkraut and study its microbiology and spoilage.
- To determine and compare effect of deep-freezing and refrigeration on the viability of microorganisms.
- To isolate and recognize the microorganisms responsible for the fermentation of yoghurt.
- To study the production of wine, vinegar, amylase, protease.
- To study of design of fermentor (batch and continuous for production of yeast)
- To determine the Dissolved oxygen concentration of fermented broth.
- To study the kinetics of growth of yeast in batch/continuous culture.

**Suggested Readings:**

Bailey, J.E. and Ollis, D.F. Bio Chemical Engineering Fundamentals (1986), Mcgraw

Hills. Rehm, H.J. and Reed, G. (ed), Biotechnology, Vol 1-2, Verlag chemie.

Stanbury, P.E. and Whitaker A., Principles of Fermentation Technology (1984), Pergamon Press.

Pirt, S.J. Principles of Microbial and Cell Cultivation. Blackwell Scientific Publication, London.

Moo-young, M. Comprehensive Biotechnology, Vol. 1-4, Pergamon Press, Oxford.

Industrial Microbiology by Prescott SC & Dunn CG, 2006 CBS Publishers, New Delhi.

Industrial Microbiology by Casida LE,1968, New Age International Publishers Ltd., New Delhi.

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -IV**

**(MFT-403 ADVANCES IN FOOD NUTRITION)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory**

**UNIT-I**

Importance of nutrition to health and growth; Relation of food and diseases; Nutritional requirement of human body & RDA.

Preparation of balanced diets; Deficiencies of essential nutrients; Effect of cooking and processing on nutrients; Nutritional value of processed foods; Therapeutic nutrition.

**UNIT-II**

Nutritional requirements of special group of people such as infants, pregnant and lactating mothers, patients, aged people.

Functional foods and nutraceuticals with attributes to control cardiovascular diseases, cancer, obesity, ageing.

**UNIT-III**

Functional aspects of dietary fibre, amino acids & peptides, antioxidants, vitamins, fatty acids etc. Assessment of nutritional quality of food.

**Practicals:**

- Identification of food sources for various nutrients.
- Instruction to diet planning using food exchange list.
- Calculation of BMI & BMR.
- Evaluation of own diet.
- Planning of diet for children, adult and old people.
- Planning of diet for patient suffering from Ulcer, Anaemia, Diabetes, Diarrhoea and Cardiac diseases.

**Suggested Readings:**

Bamji MS, Rao NP & Reddy V. 2003. *Textbook of Human Nutrition*. Oxford & IBH.

Joshi SA. 1999. *Nutrition and Dietetics*. Tata McGraw Hill.

Khanna K, Gupta S, Passi SJ, Seth R & Mahna R. 1997. *Nutrition and Dietetics*. Phoenix Publ.

Swaminathan M. 1974. *Essentials of Foods and Nutrition*. Vol. II. Ganesh

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**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -IV**

**(MFT-404 APPLICATION OF ENZYMES IN FOOD INDUSTRY)**

**Time: 3 Hours**

**Max. Marks: 100**  
**Theory Marks: 50**  
**Practical Marks: 30**  
**Internal assessment: 20**

**Instructions for the Paper Setters:**

**Theory: – Question paper will contain eight questions in all and students will be asked to attempt any five questions. All questions will carry equal marks.**

**Practical – Question Paper will be set with the mutual consent of Internal and External Examiners at the spot.**

**Theory:**

**UNIT-I**

**Classification:** Classes of enzymes, mechanism of enzyme action, Michaelis-Menten equation, Enzyme inhibition, factors affecting enzyme activity.

**UNIT-II**

Significance of amylases, protease, lipoxidases, lipase and pentosanase in baking industry.

Enzymes in starch industry – Production of modified starches, corn syrups containing glucose, maltose, glucose and fructose etc.

Enzymes in dairy industry:

- i) Natural enzymes in milk
- ii) Hydrogen peroxide Catalase treatment.
- iii) Rennin and its formation
- iv) Lactose and Miscellaneous application.

**UNIT-III**

Enzymes in fruits and vegetables products:

- i) Distribution of pectic substances and pectin enzymes in fruits.
- ii) Specific applications of enzymes in juice technology like clarification, debittering, etc.

Enzymes in meat industry–Tenderization of meat

Enzymes in brewing, mashing and beer finishing operation.

Immobilized enzymes

**Practicals:**

- Estimation of absolute and specific activity of alkaline phosphatase from crude cell extract
- Determination of activity in presence of activators.
- Determination of activity in presence of inhibitors.
- Determination of optimum pH
- Determination of optimum temperature
- Determination of  $K_m$  &  $V_{max}$
- Determination of Competitive, non-competitive inhibitors

**Books Recommended:**

Palmer, and Philip, Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Horwood Publishing Group, Chichester, 2007.

Price, N. C. and Stevens, L., Fundamentals of Enzymology. The cell and molecular biology of catalytic proteins. Oxford University Press.

Pandey, A. Webb, C., Soccol C. R. and Larroche, C. Enzyme Technology. Asiatech Publishers, INC. New Delhi, 2004.

Tucker, G.A. and Tabor, A.J., Enzymes in food processing. Springer Publisher, 1995.

Moll, M. (1999), Brewing Science, Vol I.

Reed Gerald, Enzymes in food processing. Academic Press Inc; 2nd edition, 2005.

**M. Sc. FOOD SCIENCE & TECHNOLOGY - SEMESTER -IV**

**(MFT-405 M. Sc. Dissertation)**

**Time: 3 Hours**

**Max. Marks: 100**