

**Tribhuvan University**  
**Institute of Science and Technology**



**Curriculum of M. Tech. (Food)**

**Prepared by:**  
**Food Technology Subject Committee**  
**Institute of Science and Technology**  
**Tribhuvan University**

**December, 2015**

## **This curriculum is effective from 2016**

**Name of course: M. Tech. (Food)**

### **Introduction**

In Nepal, the history of Food Technology education is over four decades old. The first Food Technology course was proficiency certificate level, introduced in 1973 (2030 BS). The years of 1980 and 2001 have set milestones in the journey of Food Technology education as in these years bachelor's degree (B. Tech, Food) and postgraduate degree (M. Tech. Food) courses were launched.

Food Technology courses provide knowledge and skill to process agricultural raw materials in value added finished products, reduce postharvest loss of primary agricultural products and prepare safe, nutritious and health friendly food products. Shelf life and quality improvement of food are other objectives of Food Technology education. The importance of this education lies in its potential to generate manpower needed in the sector of food manufacturing, food industry management, postharvest loss reduction, quality control functions of government, and education sector itself.

M. Tech. (Food) is a postgraduate course of Tribhuvan University. This course is run by Central Department of Food Technology under Institute of Science and Technology.

Complying with the university policy and program Food Technology Subject Committee has this year redesigned the curriculum of M. Tech. (Food) of annual system in semester system. In redesigning the curriculum, the Subject Committee has split old course to adjust credit hour, modified the syllabus of the existing courses to incorporate recent development in the respective fields and introduced few new courses of new and important emergence.

### **The Spear Headed Objectives of this Course**

- To impart knowledge to students about modern scientific basis of food preservation, processing, storage and packaging of food.
- To impart knowledge to students about different modern methods of food processing and preservation with implications of food engineering.
- To impart knowledge to students about process control and automation.
- To train students on use of mathematical tools to solve complex problems encountered in food manufacturing and production system.
- To impart knowledge about food safety aspects and functional foods.
- To impart in-depth knowledge and skill about industrial processing including quality aspect of different important processed food products.
- To facilitate research dissertation to be done independently by the students in the area of food technology

- To impart knowledge to students about various aspects of industrial management including management of quality.

### **Eligibility for Admission**

Candidates having a four years bachelor's degree in food technology (B. Tech Food of Tribhuvan University) or a four years bachelor's degree in dairy technology, agriculture engineering or food biotechnology from Tribhuvan University or an institute recognized by this university shall be considered eligible to apply for admission to M. Tech. (Food). The applicant should have minimum of 50% marks in his/her bachelor degree

### **Criteria for Admission**

Applicants must appear for entrance examination conducted by the office of the Dean, Institute of Science and Technology and obtain the minimum score set by the admission committee to qualify for the admission. Selection of the applicants for admission will be done on merit basis which is established based on the marks obtained in entrance examination and bachelor's degree.

### **Admission to M. Tech. (Food) by Bridge Course**

Candidates who have obtained bachelor's degree in natural science disciplines such as B.Sc. degree in physics, chemistry, botany, nutrition & dietetics, zoology or microbiology with an aggregate of minimum of second division may apply for M. Tech. (Food). These candidates must complete one year-prerequisite bridge course prior to their study of M. Tech. (Food).

### **Enrolment Quotas**

Each batch will have enrolment of 25 students in M. Tech. (Food).  
The quota for bridge course will be decided by Central Department of Food Technology (CDFT).

### **Educational System**

The educational system adopted is semester system. An academic year is divided in two semesters. A semester period is of 16 weeks and minimum of 90 working days.

### **Credit System**

The course load is given in credit points or credit. Different theory and practical courses with different credits are offered for the study of M. Tech. (Food). One credit equals 25 marks. Total credit of the whole course is 70 and the full mark is 1750. One credit hour of theory course equals to teaching of 1 hour per week and one credit of practical course equals to a practical session of four hours per week.

### **Course Code**

All courses are given codes. A course code is designated by letters (MFT) and digits (501, etc). "MFT" stands for "Master in Food Technology", numerical numbers

identifies the course title and the capital letters A and B indicate “theory” and “practical” courses respectively.

### Course Structure

The whole course of M. Tech. (Food) is taught in two academic years (four semesters). There are 15 compulsory theory courses and 10 compulsory lab-based practical courses. Additionally, second and third semesters contain sets of product technology courses as specialization courses. They all are compulsory courses however the department reserves the right to offer any one of them at a time. A course on project work is prescribed in third semester. Compulsory research dissertation is to be done in the fourth semester.

The detailed course structure containing course code, course name, course nature, and course credit, course credit hour in every semester and total credits and credit hours for the whole course is as follows:

<b>Semester 1<sup>st</sup></b>			
S. No.	Subjects	Nature of Course	Credit
1	Advanced Food Science (Food Chemistry, Biochemistry, Human Nutrition, Microbiology)	Th + Pr	3+1
2	Food Ecology	Th	2
3	Advanced Food Processing	Th + Pr	2+1
4	Numerical Methods	Th + Pr	2+1
5	Food Biotechnology	Th + Pr	3+1
6	Functional Food and Nutraceutical	Th + Pr	2+1
<b>Total</b>			<b>14+5=19</b>
<b>Semester 2<sup>nd</sup></b>			
S. No.	Subjects	Nature of Course	Credit
1	Technology of Nepalese Indigenous Food	Th + Pr	3+1
2	Food Process Engineering	Th + Pr	2+1
3	Food Plant Automation	Th + Pr	2+1
4	Food Safety	Th	2
5	Total Quality Management	Th	2
6.	<b>Specialization Subject - I</b>	Th + Pr	3+2+1*
<b>Total</b>			<b>14+5+1*=20</b>
<b>Specialization Subjects</b>	Fruit and Vegetable Technology -I Meat Technology -I Grain Technology -I Dairy Technology -I Tea and Coffee Technology-I Technology of Alcoholic and Non-alcoholic beverage-I Snacks Food Technology-I Spices and Herbal Food Technology-I Fat and oil Technology - I Sugar Technology-I		
<b>Semester 3<sup>rd</sup></b>			
S. No.	Subjects	Nature of Course	Credit
1	Food Packaging	Th + Pr	3+1
2	Food Storage Technology	Th + Pr	3+1
3	Applied Statistics	Th	3
4	Industrial Management	Th	2
5	Project Work	Pr	2
6	<b>Specialization subject-II</b>	Th + Pr	3+2+1*

		<b>Total</b>	<b>16+4+1*=21</b>
<b>Specialization Subjects</b>	Fruit and Vegetable Technology -II Meat Technology -II Grain Technology -II Dairy Technology -II Tea and Coffee Technology-II Technology of Alcoholic and Non-alcoholic beverage-II Snacks Food Technology-II Spices and Herbal Food Technology-II Technology of Fat and oil- II Sugar Technology- II		
<b>Semester 4<sup>th</sup></b>			
<b>S. No.</b>	<b>Subjects</b>		<b>Credit</b>
1	Dissertation		<b>10</b>
			<b>Total credits = 70</b>

1\* = 1 Credit Seminar

### Theory & Practical Course Description

<b>Semester 1st</b>					
<b>Theory</b>					
<b>S. No.</b>	<b>Course Code</b>	<b>Subjects</b>	<b>Nature of Course</b>	<b>Credit</b>	<b>Credit Hour</b>
1	MFT501A	Advanced Food Science (Food chemistry, Biochemistry, Human Nutrition, Microbiology)	Th	3	3
2	MFT502A	Food Ecology	Th	2	2
3	MFT503A	Advanced Food Processing	Th	2	2
4	MFT504A	Numerical Methods	Th	2	2
5	MFT505A	Food Biotechnology	Th	3	3
6	MFT506A	Functional Foods and Nutraceuticals	Th	2	2
			<b>Total</b>	<b>14</b>	<b>14</b>
<b>Practical</b>					
1	MFT501B	Advanced Food Science (Food Chemistry, Biochemistry, Human Nutrition, Microbiology)	Pr	1	4
2	MFT503B	Advanced Food Processing	Pr	1	4
3	MFT504B	Numerical Methods	Pr	1	4
4	MFT505B	Food Biotechnology	Pr	1	4
5	MFT506B	Functional Foods and Nutraceuticals	Pr	1	4
			<b>Total</b>	<b>5</b>	<b>20</b>
<b>Semester 2nd</b>					
<b>Theory</b>					
<b>S. No.</b>	<b>Course Code</b>	<b>Subjects</b>	<b>Nature of Course</b>	<b>Credit</b>	<b>Credit Hour</b>
1	MFT551A	Technology of Nepalese Indigenous Food	Th	3	3
2	MFT552A	Food Process Engineering	Th	2	2
3	MFT553A	Food Plant Automation	Th	2	2
4	MFT554A	Food Safety	Th	2	2
5	MFT555A	Total Quality Management	Th	2	2
6		<b>Specialization Subject- I</b>	Th	3+1*	4
			<b>Total</b>	<b>15</b>	<b>15</b>

Specialization Subject	MFT556A	Fruit and Vegetable Technology -I			
	MFT557A	Meat Technology -I			
	MFT558A	Grain Technology -I			
	MFT559A	Dairy Technology -I			
	MFT560A	Tea and Coffee Technology-I			
	MFT561A	Technology of Alcoholic and Non-alcoholic beverage-I			
	MFT562A	Snacks Food Technology-I			
	MFT563A MFT564A MFT565A	Spices and Herbal Food Technology-I Fat and oil Technology - I Sugar Technology- I			
<b>Practical</b>					
1	MFT551B	Technology of Nepalese Indigenous Food	Pr	1	4
2	MFT552B	Food Process Engineering	Pr	1	4
3	MFT553B	Food Plant Automation	Pr	1	4
4		<b>Specialization Subject- I</b>	Pr	2	8
			<b>Total</b>	<b>5</b>	<b>20</b>
Specialization subject	MFT556B	Fruit and Vegetable Technology -I			
	MFT557B MFT558B MFT559B	Meat Technology -I Grain Technology -I Dairy Technology -I			
	MFT560B	Tea and Coffee Technology-I			
	MFT561B	Technology of Alcoholic and Non-alcoholic beverage			
	MFT562B	Snacks Food Technology-I			
	MFT563B	Spices and Herbal Food Technology-I			
	MFT564B MFT565B	Fat and oil Technology - I Sugar Technology- I			

**1\* = 1 Credit Seminar**

<b>Semester 3rd</b>					
<b>Theory</b>					
S. No.	Course Code	Subjects	Nature of Course	Credit	Credit Hour
1	MFT601A	Food Packaging	Th	3	3
2	MFT602A	Food Storage Technology	Th	3	3
3	MFT603A	Applied Statistics	Th	3	3
4	MFT604A	Industrial Management	Th	2	2
5	MFT605	Project Work	Pr	2	2
6		<b>Specialization Subject-II</b>	Th	3+1*	4
			<b>Total</b>	<b>17</b>	<b>17</b>
Specialization Subject	MFT606A	Fruit and Vegetable Technology -II			
	MFT607A	Meat Technology -II			
	MFT608A	Grain Technology -II			
	MFT609A	Dairy Technology -II			
	MFT610A	Tea and Coffee Technology-II			
	MFT611A	Technology of Alcoholic and Non-alcoholic beverage- II			

	MFT612A	Snacks Food Technology-II			
	MFT613A	Spices and Herbal Food Technology-II			
	MFT614A	Fat and oil Technology-II			
	MFT615A	Sugar Technology-II			
<b>Practical</b>					
1	MFT601B	Food Packaging	Pr	1	4
2	MFT602B	Food Storage Technology	Pr	1	4
3		<b>Specialization Subject II</b>	Pr	2	8
			<b>Total</b>	<b>4</b>	<b>16</b>
Specialization subject	MFT606B	Fruit and Vegetable Technology –II			
	MFT607B	Meat Technology -II			
	MFT608B	Grain Technology -II			
	MFT609B	Dairy Technology -II			
	MFT610B	Tea and Coffee Technology-II			
	MFT611B	Technology of Alcoholic and Non-alcoholic beverage- II			
	MFT612B	Snacks Food Technology-II			
	MFT613B	Spices and Herbal Food Technology-II			
	MFT614B	Fat and oil Technology-II			
	MFT615B	Sugar Technology-II			

1\* = 1 Credit Seminar

<b>Semester 4th</b>					
S. No.	Course Code	Subjects	Nature of Course	Credit	Credit Hour
1	MFT 651	Dissertation		<b>10</b>	

### Syllabus

The syllabi of all courses in offer are presented in the curriculum.

### Evaluation System

There are many schemes and measures to judge students' competency. Student's overall performance is evaluated based on marks obtained in internal assessment, final semester examination, viva-voce (in case of dissertation), and project work report and seminar assignment. In addition, oral test and written class test may be taken. Class attendance is also considered for evaluation process.

### Examination

Students must have at least 80% class attendance for both theory and practical courses to qualify for appearing in the final semester examination.

Students must appear for internal assessment and final semester examination for all courses. Institute of Science and Technology conducts final semester examination while internal examination or evaluations conducted by the department. Marks of the internal examination will be as per IOST exam rules.

The duration of examination for one credit-theory courses shall be one hour and six hours for one credit-practical course.

Internal examination carries 40 % and semester examination carries 60% of the total marks. The pass mark is 50% both for theory and practical course.

The nature of the project work is experimental /field based. Evaluation of project work is done by the department. The project work is evaluated by a panel of four examiners composed of an external subject expert, internal (departmental) subject expert, project supervisor and head of department.

Students have to appear before a panel of examiners to defend the dissertation work (viva-voce). The dissertation is evaluated by a panel of four examiners composed of an external subject expert, internal (departmental) subject expert, dissertation supervisor and head of department. The pass mark is 60%.The dissertation is evaluated based on its originality, significance to the field of study, technical quality, new facts it has brought about, and justification to credit point and time. The board of examiners may add more minor evaluation criteria.

Seminar of the specialization course is organized and evaluated by the course teacher.

### **Grading Scheme**

The grading scheme is as per IOST system.



# Semester – I

**Course Title:** Advanced Food Science (Food Chemistry, Biochemistry, Human Nutrition and Microbiology)

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT 501A

**Credit:** 3

**Nature of Course:** Theory

Full Marks: 75

Pass Marks: 37.5

## Food Chemistry

### Course Description and Objective:

The main purpose of this course is to provide advanced knowledge in chemistry of food. The syllabus includes the development in carbohydrate, proteins, recent advances in texture of fruits and vegetables, water and fat holding, food colloids and interactions of food components.

### Contents:

- Introduction: Recent development in food chemistry. 1h
- Development in carbohydrates: Surface active agents derived from some selected disaccharides; carbohydrate dehydration reactions that affect food quality. 3h
- Development in proteins: Reactions of food proteins during processing and storage and their nutritional consequences; anti nutritional protein in plants. 3h
- Water and fat holding: Water holding and its measurements; relationship between water holding and microstructure of gel; fat holding and its measurement; fat holding properties of fat. 2h
- Interaction of food components: Water and other food components. 1h
- Texture: Chemistry of texture with special reference to fruits and vegetables. 1h
- Food Colloids: A brief discussion on surface activity, rheology and foam. 1h

### References

- Birch, G.G. and Shallenberger, (1977). Development in Food Carbohydrates, vol. 1. Applied Science Publisher, London. (latest edn.)
- Dickson Eric, (1992). An Introduction to Food Colloids. Oxford University Press, New York, Tokyo.

- Fennema, O.R., (1976). Food Science Part –I, Food Chemistry. Marcel Dekker Inc., New York (latest edn).
- Lee, C.K., (1980). Development in Food Carbohydrates vol. 2. Applied Science Publisher, London. (latest edn.)
- Lee, F.A., (1983). Basic Food Chemistry, 2<sup>nd</sup>edn. The AVI Publishing Company, INC. Westport, Connecticut.
- Meyer, L.H., (1987). Food Chemistry. C.B.S. Publisher and Distributor India (latest edn.)
- Mitchell, J.R. and Ledward, D.A., (1986). Functional Food Macromolecules. Elsevier Applied Science Publisher, London, New York (latest edn.).

## **Biochemistry**

### **Course Description and Objective:**

The course contains the regulation of metabolism, the specific role of coenzymes and trace elements in metabolism, biochemical changes in foods like meat, milk, fruits, vegetables and cereals. This also contains biochemistry of glands, antifreeze proteins and the role of lactoperoxidase system on preservation of milk.

### **Contents:**

- Introduction: trends in developments of biochemistry. 1h
- The roles of co-enzymes in metabolism and vitamin deficiency, enzyme deficiency and mal-absorption of disaccharides. 1h
- Regulation of metabolism and mechanism of hormone action. 1h
- Roles of trace elements in metabolism. 1h
- Metabolism of carbohydrates: Chemical events in muscular contraction, diabetes and insulin. 1h
- Metabolism of protein: Metabolism of essential amino acids, glutamine and transamidation; mammalian biosynthesis of amino acids. 2h
- Lipid metabolism: Regulation of lipid metabolism and the prostaglandin. 1h
- Biochemical changes in foods such as meat muscle, milk and milk products, fruits and vegetables and cereals. 1h
- Biochemistry of endocrine glands: Thyroid, pancreas. 1h
- Antifreeze proteins and their potential uses. 1h
- Role of lactoperoxidase system on preservation of milk. 1h

### **References**

- Fennema, O.R., (1976). Food Science Part –I Food Chemistry. Marcel Dekker Inc., New York and Basel.
- Sunny, J.L. & Nitin, Jain.,(2005). Fundamentals of Biochemistry. S. Chand & Company Ltd, Ram Nagar, New Delhi-110 055.

- Lehninger, A.L., (1975). Biochemistry. Worth Publishing Inc., New York.
- Rao, R., (1986). Text Book of Biochemistry. Prentice Hall of India Ltd. New Delhi.
- White, A. and Hondlen, F., (1978). Principle of Biochemistry. McGraw Hill Kogakusha Ltd, Tokyo, New Delhi.

## **Human Nutrition**

### **Course Description and Objective:**

About two third of the population of the developing countries are suffering from nutritional problems. Most of the problems are related to the consumption of imbalanced diets and their biological utilization. This shows that scientific diet planning needs proper consultation and advice from an expert in the field. The present course is designed to give the input of principle of nutrition and diet therapy to the highly skilled technical manpower to work to fulfill the above mentioned purpose. The course includes the basic principle of nutrition, meal planning and management, therapeutic nutrition and diet, public health nutrition and nutrition education and applied nutrition program.

### **Contents:**

- |  |    |
|--|----|
| • Introduction to advanced human nutrition.  | 1h |
| • Meal planning and management: Basic principle, food exchange list, meal planning for family, various age group and adaptation of normal diet for changing needs.   | 2h |
| • Food paths: Blocks on food paths and their remedies.   | 1h |
| • Nutritional requirements: Nutritional and food requirement during old age.   | 1h |
| • Therapeutic nutrition and diet: Principle of diet therapy; modification of diet; special feeding methods, pre and post operative diet, diet for different disease such as diabetes mellitus, peptic ulcer, liver, renal and obesity. | 3h |
| • Public health nutrition: Introduction; malnutrition, diagnosis and nutritional assessment and surveillance, group feeding.   | 3h |
| • Nutrition education and applied nutrition program.   | 1h |

### **References**

- Jelliffe, D.A., 1966. Assessment of Nutritional Status in Community. World Health Organization, Geneva.
- Kalyan B., 1986. Public Health Nutrition in Developing Countries, Academic Publisher, New Delhi.
- King, F.S. and Burgess, A. 1992. Nutrition for Developing Countries. ELBS with Oxford University press
- Kreek and Lothar A. Menu Analysis and Planning.

- Shrilaxmi, B., 1996. Nutrition and Dietetics. New Age International P. Ltd. New Delhi. Limited, New Delhi. (latest edn).
- Joshi S. A., 1992. Nutrition and Dietetics. Tata McGraw-Hill Publishing Company, India. (latest edn).
- Swaminathan, M. 1993. Advanced Text Book on Food and Nutrition, vol. I and II. Printing and Publishing Co. Ltd, Mysore, India. (latest edn).
- William, S.R., 1988. Diet Therapy. Marby College Publisher St. Louis, Toronto. (Latest)

## **Food Microbiology**

### **Course Description and Objective:**

The objective is to impart knowledge about the roles of microorganisms and food factors in causing food spoilage, food borne illnesses and transferring food properties in beneficial ways, and moreover in food safety and microbiological quality assurance and standards.

### **Contents:**

1. Groups of microorganism associated with foods biochemical changes (saccharification, proteolysis, putrefaction, acidity, flavor changes) caused by microorganisms. 3h
2. Fermented foods
  - Fermented milk: Types of dairy starters and its quality control
  - Fermented vegetables: Sauerkraut, *Sinki*, *Tama* production
  - Fermented soybean: Natto/*kinema*, tempeh, miso, shoyu production 3h
3. Food hygiene and sanitation
  - Sources of contamination: Contamination during handling and processing of foods.
  - Account of food-borne illnesses caused by bacteria and fungi with measures of their control. 3h
4. Microbiological quality control of foods
  - Sampling schemes: Quality control using microbiological criteria. Control at source.
  - Code of Good Manufacturing Practices (GMP) and HACCP concept. 3h

### **References**

- Adams, M.R. and Moss, M.O. (1996). Food Microbiology New Age International. (P) Ltd publication, New Delhi.
- Banwart G.J., (1989). Basic Food Microbiology CBS Publisher, Delhi.
- Frazier N. C. and Westhoff DC. (2005). Food Microbiology Tata McGraw Hill Publishing Company LTD.
- Cappucino J.G. and Sherman N., (2002). Microbiology. A Laboratory Manual. The Benjamin Cumming Publishing Company.

- Robinson, R. K., (1983). Dairy Microbiology Vol. I and II Applied Science, UK.
- Steinkrauss K. S. (1996). Handbook of Indigenous Fermented Foods. Marcel Dekker.

**Course Title:** Advanced Food Science (Food Chemistry, Biochemistry, Human Nutrition and Food Microbiology)

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT501B

**Credit:** 1

Full Marks: 25

**Nature of Course:** Practical

Pass Marks: 12.5

### Contents

- Determination of energy value of foods.
- Exercises on menu planning and food exchange lists.
- Preparation of post operative diet.
- Nutrition survey and food consumption survey.
- Determination of unavailable carbohydrates in foods
- Extraction and purification of food proteins.
- Determination of amino acid sequence in proteins.
- Determination of food colorings in foods.
- Purification and characterization of proteins based on molecular size, solubility and electric charge.
- Estimation of blood cholesterol.
- Determination of vit.A, B<sub>1</sub>, niacin by chemical and microbiological procedure.
- Isolation of Lactic from *dahio* of different places and product evaluation.
- Enumeration of the following bacteria from different foods including street foods and water: *Salmonella typhi*, *E-coli*, *streptococcus faecalis*, *Bacillus cereus*, *staphylococcus aureus*.
- Sterility testing of utensils, food plants and equipments.

**Course Title:** Food Ecology

**Level:** M.Tech. (Food)

**Semester:** I

**Course Code:** MFT 502A

**Credit:** 2

Full Marks: 50

**Nature of Course:** Theory

Pass Marks: 25

**Course Description and Objective:**

Food is a basic need of life. The health and nutrition of human depend on availability, consumption, and biological utilization of foods and in turn, these depend on ecological, socio-cultural, economics, demographic, health factors. It is very important to identify and analyze the factors, which influence the production and distribution, consumption and biological utilization of food so that the policies approach of the provision of food could be made for all. Therefore, the present syllabus is designed to give input to the students who could be able to explain and discuss the relationship between human and production, processing, consumption and utilization of foods.

**Contents:**

- Scope, terminologies, nutrition and ecology. 2h
- Food availability (Production and distribution): A brief discussion on land tenure; food crops; input and technology; farming system; animal production; food marketing system; food hunger and physical limits to production. 10h
- Food consumption: Factors influencing- ecological, socio-cultural, economics, demographic, food habits. 6h
- Biological utilization of foods: Environmental sanitation and hygiene; infections factors affecting. 2h
- Socio-economy: Economic and social conditions controlling the food supplies and utilization. 2h
- World population growth and future food supplies: Population growth, increased production of traditional food organism, potential but unused food organism, population growth and change food supplies. 4h
- Environmental pollution: A brief discussion on types of environmental pollution and impact on human population. 4h
- Provision of food: Scientific progress in world food production; new food technologies and their role in the world; future trends in the use of protein resources. 2h

**References**

- Bhatia, H.S., (1998). A Textbook on Environmental Pollution and Control. Galgotia Publications (P) Ltd. 5, Ansari Road, Dariya Ganj, Delhi-110 002
- Blaxter, K.S. and Lesile, (1982). Food, Nutrition and Climate. Applied Science Publisher, London.

- Boughuy, A.S., (1975). Man and Environment. An Introduction to Human Ecology and Evolution. MacMillan Publisher, New York. .
- Deatherage, F.E., (1975). Food for Life. Plerum Press, New York.
- Den Hortog, A.P. and van Staveren, W.A., (1985). Manual of Social Security in Food Habits and Consumption in Developing Countries. Wageningen. The Netherland.
- Dorothy Hollingsworth and Elisabeth Mase, (1976). People and Food Tomorrow. Applied Science Publishers, Ltd, London. .)
- Odum, E.P., (1971). Fundamental of Ecology. WB Sanders Company. .
- Readings on Nutrition and Ecology, Food Marketing System, and Food Hunger and the Physical limits to Production.

**Course Title:** Advanced Food Processing

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT503A

**Credit:**2

Full Marks: 50

**Nature of Course:** Theory

Pass Marks: 25

**Course Description and Objective:**

The successful application of modern food processing permits the conservation of desirable qualities in the stabilized food. Such stabilized foods permit their widespread distributions to meet the needs of people. With modern food processing technology, preserved foods can compete favorably with their unprocessed counterparts. Many newer food processing methods, viz., ohmic heating, microwave processing, high pressure technology, aseptic processing etc., are coming into existence and are gaining popularity in food processing technology. A fuller and deeper understanding of their underlying principles and processes will undoubtedly help explore their applicability to diverse food materials.

**Contents:**

- 1. Thermal processing** 3h  
Principle and kinetics, thermal process design using Ball's formula method, statistical nature of microbial death.
- 2. Aseptic processing** 3h  
Basic concept, heat transfer to and within particulates, residence time distribution in particulate flow, time/temperature profiles, aseptic processing systems, advantages of aseptic processing, microbiology and chemistry of aseptic processing.
- 3. Kinetics of chemical reactions in foods** 4h  
Theory of reaction rates, enzymatic reactions, product concentration limiting reaction, effects of environmental factors, use of kinetics in shelf-life prediction, food storage stability under steady and unsteady state temperature conditions, prediction of quality losses in processing and storage, temperature dependence of reaction rate.
- 4. Water activity in food preservation** 6h  
Basics of water activity, sorption isotherms, hysteresis- introduction and factors affecting, water activity shift and break in isotherms, factors affecting water activity, effect of water activity on physical, chemical and microbiological characteristics of foods, water activity prediction at low and high moisture foods
- 5. Osmotic concentration of foods** 3h  
Osmotic process, development of mathematical models, kinetics of osmotic concentration, application and problems, methods to increase osmotic rate, factors affecting osmosis.



## 6. Fresh produce storage

6h

*Controlled atmosphere (CA) storage:* Principle, heat of respiration, modeling of respiration rate, empirical, theoretical and regression models, influence of reduced oxygen and enriched carbon dioxide, combined influence of O<sub>2</sub> and CO<sub>2</sub>, safety aspects, CA generating devices, testing of air tightness, CO<sub>2</sub> scrubbers, prediction of respiration rate

*Modified atmosphere packaging (MAP):* Principles, gases used, MAP techniques, prediction of O<sub>2</sub> and CO<sub>2</sub> concentrations in an MAP, MAP of non-respiring foods.

### • Cooling of agricultural produces

2h

Introduction, mathematical expression, cooling rate, half-cooling time,

## 8. Potential food preservation methods

5h

*High pressure food processing:* Engineering aspects, biological effects, factors affecting microbial death, microbial inactivation kinetics.

*High intensity pulse electric field:* Processing system, biological effects, factors affecting and mechanism of microbial inactivation,

*Ohmic heating:* Introduction, modeling of ohmic heating process, uses

*Microwave heating:* Principles, advantages, factors affecting, industrial applications and limitations.

## References

- Martin-Belloso, O. and Soliva-Fortuny, R. (eds). (2011). *Advances in Fresh-Cut Fruits and Vegetables Processing*. CRC Press, New York
- Mathlouthi, M. (ed). (1986). *Food Packaging and Preservation – Theory and Practice*. Elsevier Applied Science Publishers, USA.
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**Course Title:** Advanced Food Processing

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT 503B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents:**

1. Determination of cold points in glass and metal containers.
2. Determination of respiratory activity of fruits and vegetables.
3. Determination of cooling parameters of different commodities under different cooling systems.
4. Osmotic concentration of fruits and vegetables.
5. Application of ohmic and microwave heating in food processing.
6. Determination of water activity of food materials using different methods.
7. Construction of sorption isotherm of different food materials.

**Course Title:** Numerical Methods

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT 504A

**Credit:** 2

Full Marks: 50

**Nature of Course:** Theory

Pass Marks: 25

**Course Description and Objective:**

The aim of the course is to introduce Numerical Methods and its importance in the field of Food Technology for successful operation and problem solving that arise in the course of study. The course emphasizes in the logical development of algorithms programming in high level language like FORTRAN, C or C<sup>++</sup> and use of CAS software like Mathematica, Matlab or Maple.

Following the successful completion of this course the students will be able to explain the importance and the role of Numerical Methods in Food Technology. Students can apply the methods of modern approximation techniques and conduct the studies of scientific computing in the most and spread professional fields. Students demonstrate motivation and responsibilities to advocate for problem solving skills to real life problems and interpret the results.

**Contents:**

- **Computer programming language: FORTRAN/C/C<sup>++</sup>/JAVA** 5h
- **Basic principle of Numerical computing system:** 4h  
Compute arithmetic, Algorithm, flowchart and software.  
Direct and iterative methods, sources and types of errors in computation.  
Approximation of function using Taylor's theorem.
- 3. **Roots of polynomial and Transcendental equation:** 5h  
Fixed point iteration and its convergency.  
Bisection method  
False position and secant method.  
Newton - Raphson method (Simple root and multiple root)  
Rate of convergency of the above methods.
- 4. **System of Algebraic equations:** 4h  
Gauss - Seidal iteration method  
Gauss - elimination method  
Lu Factorization method  
System of non- linear equation.
- **Curve Fitting : Interpolation and Regression** 4h  
Lagranges interpolating polynomials

Finite difference, Newton - Gregory forward, backward and divided difference interpolation formula.

Richardson extrapolation.

Method of least squares, linear, non-linear and multiple regression analysis

Coefficient of determination and standard error of estimates.

Curve linear regression - power equation, exponential equation, and saturation growth rate equation, geometric and trigonometric equation.

• **Numerical differentiation and Integration.** 5h

Numerical derivation of 1st, 2nd and 3rd order using interpolating polynomials and finite difference.

Differentiations using central Difference formula and Richardson's extrapolation.

General quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule.

Romberg Integration

Gauss- Legendre two-point and three-point formula.

• **Solution of ordinary and partial Differential Equation.** 5h

Euler's method of solution of IVP and BVP for first order ODE.

Range-kutta Methods - RK1, RK2, RK3 and RK4.

Simultaneous ODE by Taylor's series and Picards Methods.

Solution of wave equation, heat equation, Poisson's equation and Laplace equation using Difference Methods.

**References**

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- Douglas Faires, J., Richard Burder, L., (2014). Numerical Methods 7th edition, Thomson/Brooks/Cole Publishing Company, New York.
- Jain, M.K., Iyenger, S.R.K. and Jain, R.K., (2007). "Methods for Scientific and Engineering Computation" 5th edition, New Age International Publisher's, New Delhi.

**Course Title:** Numerical Methods

**Level:** M.Tech. (Food)

**Semester:** I

**Course Code:** MFT504B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

**FORTRAN/C/C++/JAVA based**

- Machine Computation, Development of Algorithm and flow-charting.
- Program Development of the following :
- Bisection/ Secant / Newton-Raphson methods
- Gauss- Elimination/ Lu Factorization methods
- Difference tabs/ Language and Newton interpolation.
- Trapezoidal / Simpson's  $1/3$  and  $3/8$  rule/ Romberg method of integration .
- Euler's method/ RK methods of ODE.
- Laplace equation/ Poisson's equation / heat equation and wave equation of PDE.

**Course Title:** Food Biotechnology

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT 505A

**Credit:** 3

**Nature of Course:** Theory

Full Marks: 75

Pass Marks: 37.5

**Course Description and Objective:**

To acquaint with the fundamentals of prokaryotic and eukaryotic genome and their defined manipulations through recombination, genetic engineering, and tissue culture to expedite and augment food fermentation, enzyme production, alcoholic beverages production, waste disposal and treatment etc.

**Contents:**

- Isolation, selection and screening of microorganism, preservation and maintenance of industrial microorganism.  
Medium design, medium formulation (Placket Burman Design, Box Wilson Design). 6h
- **Prokaryotic and Eucaryotic genetic make-up** 10h  
DNA structure and replication.  
DNA repair - Direct repair, Basic Excision Repair, Nucleotide Excision repair, Mismatch repair, Recombination repair.  
Gene transcription in prokaryotes post translation modification of mRNA.  
Translation of mRNA into protein, inhibitors of protein synthesis. 10h
- **Genetic engineering** 14h  
Basic technique in recombinant DNA technology gene cloning vectors, cDNA synthesis and cloning site- directed mutagenesis and protein engineering, nucleic acid amplification and its application- RT-PCR, competitive PCR, PCR coupled to DNA sequencing, ligation mediated PCR, arbitrarily primed PCR.  
Transgenic plant and Gene knockout technologies.  
Metabolic engineering and industrial products - production of vitamin 'A' to improve nutrient quality of starch, seed protein quality, oil quality diagnostic and therapeutic protein, herbicide resistance, insect resistance, post harvest losses, long shelf-life of fruits and flowers.
- **Cell culture, secondary metabolites synthesis. hybridoma technology.** 6h
- **Microbial production of Vitamins** – Riboflavin, cyanocobalamine (Vit B<sub>12</sub>), 4h  
classification of fermented foods, production of tempeh, shoyu, sauerkraut.
- **Enzyme production technology, enzyme immobilization techniques.** 4h

- **Mushroom biotechnology:** A review on nutritional and medicinal value of mushroom, production and strain improvement.

4h

### References

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**Course Title:** Food Biotechnology

**Level:** M. Tech. (Food)

**Semester:** I

**Course Code:** MFT 505B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

- DEPC ( Diethylpyrocarbonate) water preparation
  - i. Extraction of genomic DNA from plants, animals and bacteria.
  - ii. Extraction of plasmid DNA from bacteria
  - iii. DNA extraction from Agarose gel.
- Isolation of RNA by Trizol method.
- Enzyme production and extraction:
  - Amylase from bacteria
  - $\beta$ -amylase from barley
  - Caseinase by microorganism
  - Cellulose production
- To perform zymography for gelatinase.
- Enzyme immobilization through entrapment in alginate.
- To dialyze a protein sample
  - Desalting of protein solution
  - Concentration of protein sample by sephadx
- Micro-propagation of plant cell, callus culture
- Production of sauerkrant, Tempeh, Natoo, Koji
- Production of Oyster Reishi, Pleurotus spp., Ganoderma spp., Calocybespp, Auricularia spp.

**Course Title:** Functional Food and Nutraceutical

**Level:** M.Tech. (Food)

**Semester:** I

**Course Code:** MFT 506A

**Credit:** 2

Full Marks: 50

**Nature of Course:** Theory

Pass Marks: 25

**Course Description and Objective:**

Functional Foods, sometimes referred to as nutraceuticals, are foods (or food ingredients) that deliver specific non-nutritive physiological benefits that may enhance health. The growing consumer interest in Functional Foods is transforming the food industry as we know it, and redefining the relationship between food, nutrition, and health. In Functional Foods: Principles and Technology, the students will learn what constituents make a food product functional, and we will discuss the chemistry and physiological effects of functional foods, technology and development of functional foods. Students will be presented with definitions and concepts pertaining to these categories of functional foods. They will learn the importance of chemical structures and properties as well as the non-nutritive functions of several different foods in these categories.

**Contents**

- Introduction: Definition of functional foods: nutraceuticals, dietary supplements, herbal supplements, food for specific health use. 2h
- Functional food and health: Colonic, coronary heart disease, antitumorandhealth 5h
- Antioxidant: Definition, biochemical barkers of antioxidant functionality: antioxidant assays, lipid oxidation products, DNA oxidation products, plant phenolic dependent peroxidase. 4h
- Exploration of antioxidant properties of fruits and vegetables (cranberries, broccoli). 2h
- Phenolics and flavonoids as antioxidant. 2h
- Soy products: Health benefits, chemistry and biological functions of isoflavones 3h
- Processing technologies of Functional Foods and nutraceuticals: Supercritical fluid extraction, pressurized low polarity water extraction, membrane separation, bioprocess technology, preservation and packaging technology. 6h
- Developing functional food products: Maximizing the functional benefits of plant foods, functional fat and spread, functional confectionery, probiotic functional food, dietary fiber functional products, functional tea, legislation on functional foods. 8h

## **References**

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- Robert, E.C. Wildman; (Ed).Handbook of Nutraceuticals and Functional Foods. CRC Press, New York.
- John Shi, Taylor & Francis(Ed). Functional Food Ingredients and Nutraceuticals: Processing Technologies. New York

**Course Title:** Functional Food and Nutraceutical

**Level:** M. Tech. (Food)

**Semester:** I

**Course No:** MFT506B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

- Estimation of phenolic components in different i) foods, ii) herbs and iii) spices.
- Determination of antioxidant properties of different foods.
- Effects of processing on antioxidant properties of processed food.
- Development of functional food.
- Survey of functional food and nutraceuticals in local market.

# Semester – II

**Course Title:** Technology of Nepalese Indigenous Food

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT551A

**Credit:** 3

**Nature of Course:** Theory

Full Marks: 75

Pass Marks: 37.5

## Course Description and Objective:

There are different types of indigenous food products which have had been continuously used from the time immemorial in Nepal. Some products are special to the tribes and some are specific to the geographic location. Many of them are not documented yet and prepared traditionally. There is need to document and improve these products. For this purpose this course is proposed and designed to include the most popular, important indigenous food products of Nepal and abroad to study their preparation food value, quality and marketing aspect and improvement on them. This is a room to explore other indigenous food products which are important less popular and not included in the syllabus.

## Contents

- **Meat and meat products** **10 hr**
  - Introduction, history, social, religious and cultural value, traditional process knowhow, production and marketing, quality, chemical composition, nutritional value, microbiology, safety, shelf life, principle of preservation of *Choyala, Jhuku, Kachila, Momo, PhaksakoKharuwa, Pakku, Sapumhicha, Sargyangma, Sekuwa, Sukula, Sukuti*, stuffed goat lungs, *Taas, Takha (Thal-thale), Womyuk*, fish cake, *Sidra, Sukuti-macha*.
  - Assignment and class seminar on prospect of raising technology level and improving product acceptance of indigenous meat products; review work.
  
- **Fruits and vegetables Products** **8h**

*Gundruk, Sinki, Khalpi, Nimki, Mesu (Bamboo shoot), Chook amilo, DhuleAchar, Dried fruits and vegetables* : Historical Background, raw materials, methods of preparation and processing, defects, spoilage and storage, Food value, need of improvement and marketing, quality parameters, chemical composition, microbiology, safety, shelf life.

- **Cereal based indigenous products** **12h**
  - Non-alcoholic: Beaten Rice (*Chiura*), Puffed Rice (*Murai*), *Sel Roti*, *Bagiya*, *Khajuri*, *Dhikri*, *Bhakka*, *Vhusuwa*, *Thekuwa*, *Maseura*, *Kinema*.: Historical background, raw materials, methods of preparation and processing, defects, spoilage and storage, food value, need of improvement and marketing, quality parameters, chemical composition, microbiology, safety, shelf life.
  - Cereal based alcoholic beverages: **8h**  
*Jand*, *Chhang*, *Raksi*, *Tongba*, *Hyauntho*, *Nigaar*, *Marcha*.: Introduction, raw material, preparation method, composition, food value, quality and defect, storage, need of improvement and marketing.
- **Milk based indigenous products** **8 hr**  
*Dahi*, *Ghee*, *Churpi*, *Kurauni* etc.: Introduction, method of preparation, raw material, composition, food value, uses, quality and defects, spoilage problems, quality improvement, market.
- Survey of different traditional and indigenous food products. **2h**

## References

- Ad Hoc Panel of the Board on Science and Technology for International Development, (1992). Applications of Biotechnology to Traditional Fermented Foods', Office of International Affairs National Research Council, National Academy Press, Washington, D.C.
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- Yonjan, H., (2007). Studies on *Selroti* , a Traditional Fermented Rice Product of the Sikkim Himalaya: Microbiological and Biochemical Aspects

**Course Title:**Technology of Nepalese Indigenous Foods

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT 551B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

- Preparation and analysis of different Nepalese indigenous food.
- Study of the effect of raw material and process variable on the quality and shelf life of indigenous food products. (meat and fish Product, fruits and vegetable based product, milk basedproducts, cereal based products, cereal based alcoholic beverages).
- Development and design of traditional food product industries.
- Survey of different traditional food products of Nepal.
-



**Course Title:** Food Process Engineering

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT552A

**Credit:** 2

**Nature of Course:** Theory

Full Marks: 50

Pass Marks: 25

**Course Description and Objective:**

The ever growing demand for the wholesome, nutritional and high quality processed foods is placing greater emphasis on the engineering aspects of presses and equipment utilized during handling, processing and distribution of foods. Food process engineering is a vital aspect of multidimensional food processing system. Deeper understanding already evolved discipline will make the students more conversant when they face the reality of food processing system.

**Contents**

- **Heat transfer:** Introduction to steady state and unsteady heat conduction, Analytical and numerical solutions of unsteady state conduction, Transient heat flow in semi-infinite solids and in multidimensional system, Use of Gurnie-Lurie and Heisler charts in solving heat conduction problems, boundary conditions in heat transfer, Biot and Fourier Numbers.

5h

- **Membrane technology:** Theory and application of dialysis, reverse osmosis and ultra-filtration, membrane modules with operation, polarization and limiting factors in membrane processing.

4h

- **Fluid mechanics:** Concept of natural and apparent viscosity, design equations for laminar and turbulent flow in tubes, pressure and friction losses, theory and working of rotational and capillary flow viscometers, shell momentum balance inside a pipe.

4h

- **Drying of grains:** physical and thermal properties of cereal grains, theoretical and empirical approaches of grain drying, Luikov's approach and single kernel drying, mechanical drying systems, thin layer and deep bed drying.

4h

- **Freezing, freeze drying and freeze concentration:** Freezing rate and time calculation by different methods, principle and application of freeze-drying, heat and mass transfer in freeze drying with limiting factors, theory and practice of food thawing, freeze-drying time calculation, theory and application of freeze concentration.

5h

- **Thermal and rheological properties of foodstuffs**

*Thermal conductivity* – Theoretical and semi empirical models, experimental methods of measurements (steady state and transient methods), predictive equations.

*Rheological properties*: Fundamental concept, Newtonian and Non-Newtonian foods, semi-solid foods – creep complaint, creep curve, stress relaxation, dynamic properties of foods.

- **Extraction**

4h

*Solid liquid extraction* – Leaching: Introduction, extraction systems, graphical representation, extraction rate, different streams and location of streams in phase diagram, Principles and application of liquid- liquid and supercritical fluid extractions.

8. **Extrusion cooking**: Background, single, and twin-screw extruders, extrusion process. 2h

## References

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**Course Title:** Food Process Engineering

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT552B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

- Determination of flow behavior index using tube flow and rotational viscometer.
- Determination of pressure drops in tube flow.
- Determination of thermal conductivity and surface heat transfer coefficient of foodstuffs.
- Determination of freezing time.
- Experiment related to the use of membranes in food industries.
- Experiment related to extrusion cooking.

**Course Titles:**Food Plant Automation

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT553A

Full Marks: 50

**Credit:** 2

Pass Marks: 25

**Nature of Course:** Theory

**Course Description and Objective:**

The enormous and rapid increase in the measurement, recording and control of critical variable in industrial processes has led to a corresponding expansion of instrumentation technology;to gain full advantage of instruments it is imperative to have a good knowledge of the theory and methods of handling and caring instruments. The objective of this course is to provide theoretical and practical knowledge about instruments that are being used in industries and research institutions.

**Contents:**

- Background of plant automation and its importance in food process industries, process variables in food processing industries: Canned and bottle fruits and vegetables, beer, soft drink, sugar, milk powder, black tea and biscuits. 3h
- Automatic weighing systems: Analytical balance, spring balance and load cells. 2h
- Displacement measurements: Strain gauge, LVDT, capacitance gauge & piezoelectric transducers. 3h
- Measurement of velocity, acceleration & torque: Revolution counter, capacitativetacho, dragcup type tacho, tachogeneration, stroboscope, accelerometer, etc. 3h
- Pressure measurement: Bourdon tubes, diaphragm elements, bellows, vacuum gauges and differential pressure transmitters, transducers. 3h
- Turbidity and color measurement: Turbidity meters, light scattering type, absorption type, reflectance type color measurement, digital imaging processing method. 2h
- pH, humidity, viscosity and density measurement, sensors, biosensors. 4h
- Temperature measurement: Thermocouple, thermopile, thermistors, radiation & optical pyrometer. 2h
- Flow measurement: Mass flow meters, positive displacement meters, electrical type flow meters, open channel flow measurement, liquid level measurement. 3h
- Moisture measurement: Standard methods, moisture measurement cell for granular material, capacitance probe, resistance method, IR method, NMR method. 3h
- Timers: Classification, electrical timers and design of timers. 1h

- Operational aspect of instrument system: Introduction, control centre requisites, control panel, graphic panel, diagrammatic references instruments, actuators and control, signal conditioning, signal transmission, process control etc.; line diagrams aspects of operational convenience; annunciation, scanning and data logging.

3h

### **References**

- Gray,B.F. Longman (1977): Measurement, Instrumentation and Data Transmission, London and New York,
- Kress-Rogers,E. &Brimelow, C.J.B., Instrumentation and Sensors for the Food Industry. 2nd Ed. CRC Press and WoodheadPublishing.
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**Course Title:**Food Plant Automation

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT553B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

- Measurement of deformation by using strain gauge.
- Calibration of Bourdon tube pressure gauge by a mercury column manometer.
- Measurement of strain.
- Study of characteristics of thermocouple and thermistors.
- Measurement of thermal conductivity of liquids.
- Measurement of high vacuum pirani gauge.
- Simulation of a control system on a desk-top digital computer.
- Studies on automation in any one of the food industries.
- Studies of AC timer.
- Photometric measurement.
- pH measurement using a microprocessor.
- Studies on characteristics of transducers.

**Course Title:** Food Safety

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT 554A

Full Marks: 50

**Credit:** 2

Pass Marks: 25

**Nature of Course:** Theory

**Course Description and Objective:**

The main objective of the course is provide knowledge on general food safety issues, risk assessment principle and process for microbial and chemical contaminants and its application on risk management and communication. The course provide student with basic concept of food safety and build skill in risk analysis of food with combination of formal lecture, report writing and case studies. It also gives basic concept in management of risk as well as economic aspect of food safety.

**Contents:**

- **Food safety:** Background. 2h
- **Gram positive food borne pathogen and toxin former:** 2h  
*Clostridium botullinum**Staphylococcus aureus*, *Bacillus cereus*, *Listeria monocytogenes*(organism and its characteristics, pathogenesis and clinical feature, isolation and identification, and association with foods).
- **Gram negative food borne infectious pathogens:** 2h  
*Salmonella*, *Enterobacteriaceae*, *Campylobacter*(Organism and its characteristics, pathogenesis and clinical feature, isolation and identification, and association with foods).
- **Risk assessment of food:** Introduction, principle of risk assessment, risk management and communication. 10h  
Microbial risk assessment of food: Hazard identification, hazard characterization, exposure assessment, risk characterization, food safety objective and its practical consideration, microbial dose response model, analysis of MRA, case studies.  
Toxicological risk assessment of food: Hazard identification, hazard characterization, exposure assessment, risk characterization, risk assessment of non-carcinogens and carcinogen; margin of exposure concept, virtual safe dose approach, linear and other method for extrapolation of animal toxicity data to human level ,uncertainties in risk assessments, PBBK model and application in risk assessment, case studies.
- **Toxicology of processed food:** 3h  
Introduction, toxicological concern of heat processing, compound formed from pyrolysis of fat, proteins, amino acids, Millard reactions and oxidation of fat, case study: benzo( $\alpha$ ) pyrene, acrylamide and furan.
- **Food additive and safety concerns:** 3h  
Introduction and importance in food, classification based on safety evaluation regulation and labeling, health aspects of food additives, authorization and standard setting of food additives.

- **Organic farming and food safety concerns:** 2h  
Introduction, organic farming and food safety aspects: Zoonosis virus and parasites, prions, and chemical risks.
- 8. **Labeling:** 2h  
Introduction, importance, regulation on labeling: Nepalese aspects and European aspects, labeling issues of biotechnology derived foods, health and nutritional claim food, food containing allergens.
- 9. **Mycotoxins** 2h  
Major classes of mycotoxin concerns: *Aspergillus*, *Penicillium* and *Fusarium* mycotoxins.
- 10. HACCP, food safety management system general concept. 2h
- Food safety economics, general concept. 2h

## References

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**Course Title:**Total Quality Management

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT 555A

**Credit:** 2

**Nature of Course:** Theory

Full Marks: 50

Pass Marks: 25

**Course Description and Objective:**

We are in a changing time. Globalization has created more competition and opportunities as well. To meet the competition in quality products and services TQM system has become successful with the idea of continuous improvement. It helps to prepare quality products and services. The course contains TQM, FQC, TQC, and SQC. Quality circles. KAIZEN. ISO-9000 series. ISO-14000. HACCP. GMP etc. The course make the students aware of the modern managerial skills for satisfying the customers, industrial quality products as well as in the services sector. In general the students will acquire knowledge about quality of life through quality of products and services. TQM is part of a holistic approach to the future progress.

**Contents:**

- Introduction, evolution, concept and philosophy of TQM. (quality models of Deming, Juran, Ishikawa, Crossby), elements and principles of TQM, seven tools of TQM 8h
- The management of QM, TQC, CWQC 1h
- Focused quality management and understanding Critical Success Factors (CSF) 2h
- Policy management and its diagnosis. 1h
- People first and team building. 1h
- Variation of 5 MS (Man, Mind, Money, Machine and Materials). 1h
- HACCP plan, principle and practices. 2h
- Quality control circles and its importance. 1h
- Introduction and use of ISO standard series in the food industries. 4h
- Communication in the food industries. 1h
- Quality of profit and cost of quality. 1h
- Management by objectives (MBO). 2h
- General ideas of food laws of Nepal and enforcement problems. 2h

- Study, observation and reporting of present management system in any industries or service organization and identification of improvement points. 2h
- Basic concepts of management information systems(MIS) and supports to business functions (manufacturing , sales & marketing, human resources, accounting, manufacturing etc); managing organizational data and information. 3h
- Introduction to the contemporary MIS approaches for data processing and database management, system analysis and design, office automation. 2h
- Business Applications- enterprise business systems and decision support systems Introduction to e-commerce, types – B2B, B2C, C2B, C2C etc and application ; 2h
- Material Resource Planning (MRP) and Just in Time (JIT) in food sector. 2h
- Basic elements of lean production 2h

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**Course Title:** Fruit and Vegetable Technology- I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT 556A

**Credit:** 3+1\* (1\*= Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

**Course Description and Objective:**

This course deals with post harvest physiology and storage of fruits and vegetables in general. Package house operation, storage of fruits and vegetables, storage disorder, packaging design, equipment for fruits and vegetable processing, aseptic processing of fruit and vegetable products have got priority in this course.

This course provides intensive knowledge of post-harvest physiology, preservation and processing of fruits and vegetable and stimulates food technologists for research in this area. Provision of seminar will increase the self involvement and participation of student in learning practice.

**Contents**

- Introduction, definition, composition, nutritive value, functional components and important of fruit and vegetable in diet. 4h
- Major fruits and vegetables and production area in world. 1h
- Fruits and vegetables production scenario in Nepal. 1h
- Different stages in life span of fruits and vegetable and physiological and biochemical changes during maturation, ripening and senescence. 5h
- Maturity standard, its assessment and harvesting methods. 2h
- Post harvest treatments and packaging house operations of fresh fruits and vegetables. 4h
- Storage of fruit and vegetable: natural storage, cellar storage, zero energy cool chamber, low temperature storage, underground storage, hypobaric storage, MAS, CAS and recommended conditions for individual commodities, frozen storage, use of ice etc. 8h
- Storage disorders and their control. 3h
- Role of plant growth regulators and plant hormone: (ethylene:-role, biosynthesis and limitation). 3h
- Minimally processed fruit and vegetable products. 2h
- Equipments for the manufacture of fruits and vegetables products. 4h
- Aseptic processing of fruits and vegetable juices and beverages. 4h
- Packaging design for fruit, vegetable and their products. 3h
- Regulations in relation to fruits and vegetable juices and beverages. 2h
- Sensory evaluation: principle, use of software. 2h
- **Seminars** 16h

**References**

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**Course Title:** Fruit and Vegetable Technology - I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT556B

**Credit:**2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Contents**

- Estimation of storage life of important fruit and vegetables by different storage methods.
- Study on handling and transportation losses of fresh fruits and vegetables.
- Study on effect of packaging variables on fresh fruit and vegetable produce.
- Determination of color and texture of fruit and vegetable.
- Formulation of fruit and vegetable beverages.
- Sensory evaluation of fruit and vegetable juices and statistical analysis.
- Study on the effect of processing variables on nutritive value of processed fruit and vegetable products.
- Visit of cold storage facilities.
- Class seminar—one seminar for each student.
- Study of functional component in fruits and vegetable.

**Course Title:** Meat Technology-I (Quality, Preservation, Safety)

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT557A

**Credit:** 3+1\* (1\* = Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

**Course Description and Objective:**

This course aims to deal extensively with quality, preservation and safety aspects of meat and meat products. These aspects of meat are so important to sustain and develop meat business and save meat from loss. The course is divided in four parts. The first part covers the chemistry, biochemistry of muscle, factors affecting the quality of meat and meat product; spoilage and quality measurement. Practical implications are in the center of attention. Also, this part contains the scenario of adulteration and different fraudulent practices encountered in meat business. Second part covers the practical aspects of different meat preservations methods and provides information on merits and application of recent food preservation methods as applicable to meat. The third part of the course deals with the practical approaches to assuring safety of meat. The last part is devoted to analysis and quality control. Class seminars are extra conducted with objective to build up analytical capability of students in quality, preservation and safety aspects of meat and meat products. Self-study assignment of important topics to students, presentation of critical issues and trends by students about the assigned topics, and intensive group discussion will constitute the class seminar. Basic knowledge about slaughtering and meat production, postmortem biochemistry of muscle, chemistry, quality, preservation and processing of meat is prerequisite for this course.

**Contents**

• **Quality of meat**

13h

Perception of meat quality; quality indicators of meat (pH, water holding capacity, colour, tenderness, odour, taste, intramuscular fat, fat quality, connective tissue, etc.); chemistry and biochemistry of muscle with important bearing on quality of meat and meat processing; Influence of animal production practice, animal species, breed, feed, age, sex, genetic type, etc. animal related factors on meat quality; Extrinsic factors affecting meat quality and their practical implications: factors and effects, chemical and biochemical process in colour, odour and tenderness changes in meat during storage and processing; freezing rate and meat quality, effect of refrigeration on colour and texture, drip loss, evaporative weight of meat, chemistry of water binding and fat binding and its practical considerations; Muscle enzyme system and meat quality Meat tenderization methods and their application; Chemistry of meat flavor: flavor precursors, reactions and reaction pathways, species specific flavours, reaction governing factors, processing and storage effects; Spoilage of meat: factors, agents and conditions for spoilage of meat; Off flavour development in meat due to chemical reactions.

- **Meat preservation**

19h

Brief overview of common meat preservation methods; chilling of meat: chilling systems, chilling process, chilling of different species meat, factors affecting chilling process and meat, process design consideration; freezing of meat: freezing systems, freezing meat block, hot meat and special products, thawing of frozen meat; effect of chilling and freezing on drip loss and evaporative weight loss of meat; chilled and frozen storage and retail display: packaging, storage system and type of storage; transportation of frozen and chilled meat: refrigeration systems during transportation; high hydrostatic pressure processing of meat: equipment, operation, process, changes in structural, sensory, functional properties, effect on microorganisms and enzymes; meat processing by irradiation and high voltage pulse technique: equipment, operation, process, effect on microorganisms; meat preservation by protective culture and bio-preservation: protective bacterial culture, active substance, mode of action, methods; decontamination of carcass by hot water, steam, organic acids and irradiation; active packaging (including antimicrobial packaging) for extension of shelf life of meat: active substances, mode of action, target factors, commercial application; controlled atmosphere and modified atmosphere packaging; intelligent packaging.

### **3. Meat safety**

10h

Pathogenic microorganisms of meat and processed meat products: type, occurrence, characteristics, growth conditions, adverse health effect caused by pathogens, preventive control measures; overview of mycotoxin contamination in meat and meat products and transmissible diseases; toxic residues in meat and contaminants in meat and meat products: type (environmental contaminants, veterinary drugs, agro-chemicals, processing aids, sanitizing agents, compounds incidental to processing), substances used, occurrence and source, toxic effect, control; national regulations regarding animal health, animal transport, slaughtering and meat production, sale of meat, use of food additives, residue level; international regulatory provisions (code of practice, guidelines, recommendations, standards) for meat and meat products- meat hygiene, microbiological standards, maximum permitted level of food additives, maximum residue level.

### **4. Analysis and quality control of meat and processed meat product.**

6h

Analysis of physical and electrochemical properties of meat, objective measurement of colour, texture and flavor (and off flavour), analysis of chemical composition and nutritional quality of meat and processed meat products, detection of adulteration (species, sex determination), analysis for additives/processing aids in processed meat products, measurement of progress of biochemical process like proteolysis and lipolysis in processed meat product, analysis for chemical contaminants/toxic residues and reaction products in meat and processed meat products, analysis of microbiological hazards and spoilage, sensory evaluation.



- **Class seminar**

16h

The topics for class seminar are functional compounds from meat, bioactive peptides derived from muscle proteins, feed effect on antioxidant property of meat, meat quality of individual animal species, local case study related to meat safety, document development for HACCP application for meat production and manufacture of processed meat products, current incidences of meat borne diseases and epidemic, critical issues of meat safety, adulteration practice, CO<sub>2</sub> footprint study of animals, tracing technique, production of health hazardous substances during processing, biotechnological techniques of detection of pathogens, etc.

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**Course Title:** Meat Technology-I (Quality, Preservation, Safety)

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT557B

**Credit:**2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

### **Course Description and Objective:**

- Provide skill to analyze different quality and safety parameters of meat and meat products.
- Build capability in students to interpret the test results about meat products and provide judgment on its quality and safety condition.
- Provide practical knowhow about new methods of meat preservation.

### **Contents**

- Determination of connective tissue protein in meat and meat products.
- Detection and determination of food additives (colouring matter, nitrite, nitrate) in sausage and cured meat products.
- Measurement of pH,  $a_w$ , electrical conductivity and water holding capacity.
- Measurement of lipid oxidation by determining TBRS.
- Instrumental measurement of colour and texture of meat.
- Test of meat for hygienic quality and important meat microorganisms (e.g. *fecal coliform*, *salmonella spp.*, *E. coli 0157*, *C.jejuni*, *L.monocytogenes*).
- Test of meat products for toxic residues and contaminants: antibiotic residue (e.g. penicillin, tetracycline, oxytocin), environmental contaminants e.g. lead, dioxine, sanitizer/disinfectant e.g. chlorine,  $KMNO_4$ , residues incidental to processing e.g. benzo-a-pyrene in smoke.
- Case study (project work) on analyzing market meat and meat product samples and establish the study outcome.
- Experiments on ice bank chilling and hot water decontamination of meat.

### **References**

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**Course Title:** Grain Technology-I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT558A

**Credit:** 3+1\*(1\* = Seminar)

**Nature of Course:** Theory

Full Marks: 100

Pass Marks: 50

### **Course Description and Objective:**

Grain is produced heavily throughout the world. General knowledge on grain processing has already been introduced in bachelor level course. In this course advanced level knowledge on grain processing will be provided to the students. Students will study the advanced methods of major cereal grain processing and utilization like Wheat, Rice and Maize.

It is expected that the students after completing this course will be able to handle and solve the problem related with major grain processing and their utilization.

### **Contents**

- Introduction: Back ground, over view of grain production, nutrition distribution and utilization. 1h
  - Technological properties of grain: Anatomy of grain, microstructure of endosperm, physico-chemical, mechanical, bio-chemical, thermo-physical and electro-physical properties of grains. 5h
  - Modern flour milling: Cleaning, grading, conditioning, break system, scratch system and reduction system, operation of rollers, plain-sifter and purifiers, modern Buhler milling system, milling of durum wheat, hard wheat, milling of soft wheat. 18h
  - Modern rice milling: Modern methods of paddy milling and its machines operation, milling technology of rice European, Japanese and X-M process, types and operation of huskers, separators, polishers and graders. 10h
  - Parboiling of paddy: Modern method of parboiling, soaking, steaming & drying theory & process operation. European, Japanese and other new advance methods. 7h
  - Corn. Technology: Microstructure of corn endosperm and its nutritional status, dry milling of corn, corn grits, corn flakes, wet milling of corn, current wet milling practices. 7h
- Seminar** 16h

Micro-structure of wheat & rice, physical properties of grain, milling calculation table & grade formation, pill process control, food safety & hygiene in flour & rice mill, quality & quality control of grain & its products, wheat flour mill & rice mill

management, design of flour mill, rice mill and grain dryers, traditional corn food & its development, value addition etc., extruded & alkaline cooked corn products.

## **References**

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**Course Title:** Grain Technology-I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT 558B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Contents**

- Determination of physical, physico-chemical, mechanical thermal, electrical properties of grain.
- Experimental milling of wheat, milling, and table preparation testing of flour for various usesproject work.
- Experimental milling of paddy and project work.
- Experiment of parboiling and design of parboiling plant.
- Experiment of paddy soaking, steaming drying patterns.
- Quality determination of wheat flour.
- Preparation & quality evaluation of corn grits, corn flakes and corn extruded.
- Visit and study flour mills, rice mills and corn process mills and report and writing.

**Course Title:** Dairy Technology-I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT559A

**Credit:** 3+1\*(1\*= Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

### **Course Description and Objective:**

Dairy Technology-I aims to provide knowledge on milk and the basic operations carried out in processing of fluid milk. Emphasis has been given on the process and equipment involved in the production of pasteurized-, UHT-, and sterilized milk. This knowledge is considered a prerequisite for Dairy Technology – II, where more varied types of milk products are discussed.

### **Contents**

- **Dairy chemistry:** Milk constituents, processing implications. 6h
- **Physico-chemical properties of milk:** An overview, processing implications, and changes during processing. 6h
- **Microbiology of milk:** Microflora of raw milk, microbiology of pasteurized-, UHT-, and ESL- milk. Post-sterilization contaminants, microflora of ESL milk, measures to reduce bacterial contamination of raw and market milks (including use of biopreservatives, multi-target attack/integrative approaches, etc.). 6h
- **Milk processing operations:** Milk collection and reception, platform- and quality tests (including adulteration test), reception and associated operations, production fluid milk (market-, UHT-, and sterilized milk). 16h
- **Building blocks of dairy processing:** Heat exchangers; clarifiers and separators; homogenizers; evaporators; pumps, valves and fittings; tanks; service systems. 6h
- **Aseptic packaging of milk:** machine, operations and storage. 2h
- **Fermented milk:** Production and quality control/analysis of yogurt (different types), *dahi* and its variants, buttermilk, kefir, koumiss, probiotic dairy products, starter technology, nutritional aspects of fermented milk products. 6h
- **Seminar.** 16h

### **References**

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- Walstra, P., Wouters, T.M., and Geurts, T.J. (2006). Dairy Science and Technology (2<sup>nd</sup>edn). Taylor and Francis, New York

**Course Title:** Dairy Technology-I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT559B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

### **Contents**

This course teaches the students to carry out quality analysis of raw and processed milk. Students will also learn to standardize milk and prepare pasteurized milk. Study of machines like cream separator and homogenizer will familiarize them with the operating principles.

- Detection of adulteration of milk, butter and ghee (preservative, neutralizer, starch, urea).
- Prepare pasteurized milk by holder process and check adequacy of pasteurization by phosphatase test.
- Carry out platform test of milk.
- Carry out quality test of raw and processed milk.
- Carry out cream separation and calculate the skimming efficiency.
- Study of homogenizer and pasteurizer.
- Field visit of dairy plant at nearby place.



**Course Title:** Tea and Coffee Technology-I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT 560A

**Credit:** 3+1\*(1\*= Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

**Course Description and Objective:**

The following course intends to impart theoretical and practical knowledge on the technology of tea and coffee. After the completion of this course, the students will gain theoretical and practical knowledge on the technology and chemistry of tea and coffee along with plant designs.

**Contents:**

- **General:** Historical background, cultivation, statistics of production, marketing prospects. 4h
- **Concepts of general physiology of tea and coffee.** 2h
- **Chemistry and biochemistry (tea and coffee):** Chemistry, composition, chemical reactions during processing, aroma precursors; flavor components and quality attributes. 12h
- **Technology** 28h
  - **Tea:**  
Handling and treatment of tea leaf from field to factory, manufacturing, grading, packaging and storage of green (pan-fried and steamed), orthodox, semi-fermented (Oolong), CTC tea and instant tea.  
Engineering principles of different machineries used in manufacturing and processing of different types of tea (green, orthodox, semi-fermented (Oolong), CTC tea and instant tea).
  - **Coffee:**  
Natural and wet processing of coffee cherry to green coffee bean, production of parchment coffee, processing of green coffee beans to instant coffee; grading, packaging and storage of different forms of coffee.  
Engineering principles of different machineries used in manufacturing and processing of different forms of coffee (green coffee beans, roasted coffee, ground coffee, and instant coffee).
  - Organic tea and coffee: requirements, production system and quality.
- **Processing plant designs for tea and coffee** 2h
- **Seminars** 16h  
Status of tea estates and tea technology in Nepal, status of coffee process technology in Nepal, tea and coffee culture, functional properties of tea, organic farming in tea and coffee, health benefits of tea and coffee, need of tea and coffee auction in Nepal, implication of Nepalese tea and coffee export, problems in tea manufacturing in Nepal, green, CTC and orthodox teas of Nepal, coffees of Nepal, tea and coffee culture etc. Need of plant automation in tea and coffee factory.

## **References**

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**Course Title:** Tea and Coffee Technology-I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT560B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

### **Contents**

1. Preparation of cherry coffee.
2. Preparation of parchment coffee.
3. Grading of coffee beans.
4. Proximate analysis of processed coffee.
5. Estimation of caffeine in processed and instant coffee.
6. Estimations of tannins in different types of tea.
7. Design of coffee roasters and related machineries.
8. Layout design of tea and coffee processing plant.
9. Visit to Tea-estate and coffee industry.

**Course Title:** Technology of Alcoholic and Non-alcoholic Beverages - I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:** MFT561A

**Credit:** 3+1\*(1\*=Seminar)

Full marks: 100

**Nature of Course:** Theory

Pass Marks: 50

### **Course Description and Objective:**

The following course intends to impart theoretical and Practical knowledge on the technology of alcoholic and non-alcoholic beverages. The term beverage has been contextually reserved of liquid drink other than water. Tea, Coffee and similar products that are not available as liquid have been excluded from this course,

After the completion of this course, the students will gain the theoretical and practical knowledge on the technology of non-carbonated, non-alcoholic beverages, un-distilled alcoholic beverages and be able to carry out quality control and analysis of alcoholic and non-alcoholic beverages.

### **Contents**

#### **Fruit Juice Based Beverages**

21h

1. General: introduction, types, production statistics.
  - Extraction of juice: method for fleshy fruits (pack press, horizontal rotary press, centrifuge), use of enzymes, juice extraction from citrus fruits.
  - Juice concentration: concentration by evaporation, freeze-concentration, hyper- and ultra-filtration.
  - Dilutable beverages: nomenclature, ingredients ( fruit components, sweeteners, other ingredients), manufacturing operation, filling and packaging, product range.
  - Ready-to-drink beverages: formulation, manufacturing, packaging.
  - Fruit juice and nectars: processing (flash pasteurization, in-pack pasteurization, hot filling, high pressure pasteurization), packaging.
  - Nutraceutical beverages and sports drinks: general concept.
  - Waste treatment: review of solid and liquid waste disposal system.

#### **Wine Technology**

12h

- General: introduction, classification of wine, wine production statistics.
- Red Wine: grape varieties and composition, wine production methods.
- White wine: grape varieties and composition, wine production method.

- Sparkling wine: types, production methods.
- Fortified wine: types, production methods.

### **Brewing Technology**

15h

- General: introduction, classification, production statistics.
- Ingredients for brewing: detailed description of malt, water, adjuncts and hops.
- Brewer's yeast: classification, preservation and maintenance, mutation, propagation.
- Production: manufacture of lager and other beers.
- Overview of cereal-based traditional alcoholic beverages.
- Waste treatment: review of general methods of effluent treatment.

### **Seminar**

16h

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**Course Title:**Technology of Alcoholic and Non-alcoholic Beverages - I

**Level:** M.Tech. (Food)

**Semester:** II

**Course No:**MFT561B

**Credit:**2

**Nature of Course:** Practical

Full marks: 50

Pass Marks: 25

**Contents**

- Physiochemical analysis of fruit juice
- Extraction of juice using different methods
- Preparation of RTD fruit juice (pineapple, pears, etc.)
- Preparation of dilutables (squashes/cordials)
- Isolation of wine yeasts from different sources
- Preparation of wine (grapes and other fruits) and analysis (sensory and physicochemical)
- Physicochemical analysis of malt
- Beer preparation and analysis (sensory and physicochemical analysis)
- Factory visit and process plant design



**Course Title:** Snacks Food Technology-I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 562A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Snack Food Technology-I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 562B

**Credit:** 2

**Nature of Course:** Practical

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Spices and Herbs Technology-I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 563A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Spices and Herbs Technology-I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 563B

**Credit:** 2

**Nature of Course:** Practical

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Technology of fat and oil - I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 564A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:**Technology of fat and oil - I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:**MFT 564B

**Credit:** 2

**Nature ofCourse:** Practical

Full marks: 50

Pass Marks: 25

**Course will be developed later**

**Course Title:** Sugar Technology – I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 565A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Sugar Technology - I

**Level:**M.Tech. (Food)

**Semester:** II

**Course No:** MFT 565B

**Credit:** 2

**Nature of Course:** practical

Full marks: 50

Pass Marks: 25

**Course will be developed later**



# Semester – III

**Course Title:**Food Packaging

**Level:** M.Tech. (Food)

**Semester:** III

**Course No:**MFT601A

**Credit:** 3

**Nature of Course:** Theory

Full Marks: 75

Pass Marks: 37.5

## Course Description and Objective:

The main objective of this course is to provide modern concept and application of science and engineering in food packaging. The core topics of this course are design, construction, performance and use of main modern packaging materials, technology of modern and advanced methods of food packaging, shelf life of prepackaged food and its estimation and product-package compatibility. Fundamental principles of food packaging technology are prerequisite to this course.

## Contents:

- Introduction to recent development in food packaging. 1h
2. Paper and paper board –manufacturing process of different types of paper and paper board, properties and uses. 3h
3. Paper and paper board based packaging- type, materials, converting and fabrication, design or style, filling machine and operation, printing, labeling, performance characteristics, food packing uses of different package forms and accessories. 3h
4. Plastics-raw materials, basic manufacturing process, structure, properties, converting, performance improving process, and uses of different plastics. 4h
5. Plastic based packaging: material, design, construction, printing, labeling, use, filling machine and operation, performanceof plastic packages. 3h
6. Glass containers-general manufacturing process of glass container, type, design, labeling, use, performance properties of glass container, type of closure (seal), cap type and cap liner; capping operation and machine. 3h
7. Metal based packaging-type, manufacture, chemical composition, coating, lacquering, labeling, shape, design, can making process, performance, use, filling machine and operation, etc. of different type of metal containers e.g. can, drum and aluminium foil, metal strap, etc. 3h
8. Special packaging techniques -gas packaging, vacuum packaging, shrink packaging, stretch wrapping, aseptic packaging, etc.-principle, packaging materials and package forms, equipment and working, use. 2h
9. Protective edible coating-principle of protection, desirable properties of coating material, coating materials and preparation, process of coating including methods and equipment. 2h

10. Modified atmosphere packaging- principles of MAP, type of MAP, MAP gases and their role, packaging materials and selection criteria, package forms, methods of modifying atmosphere, equipment and working, quality assurance of MAP, MAP of different types of foods. 3h
11. Active packaging (oxygen scavenging, ethylene scavenging, carbon dioxide scavenging, carbon dioxide emitting, humidity control, odour removal and aroma emission, freshness indicator packaging)-present state of commercial application, principle of protection of food by active packaging, active substances, chemistry of scavenging and atmospheric control, packaging materials and package forms, active packaging technique and process control, active packaging of different foods. 5h
- Antimicrobial packaging (AMP)- present state of commercial application, principle of protection of food by AMP, antimicrobial agents and their use in food, packaging materials and package forms, techniques of AMP, AMP system. 3h
  - Product-package compatibility-chemical migration from packaging material to food, product-package interaction, flavor scalping, sensory and compositional changes due to migration, food safety and assessing risks, factors controlling migration and toxic effects, regulation and quality control. 3h
  - Mass transfer and permeation kinetics of gases, aroma, and water vapor- mass transfer through small, intermediate and large pores, hydrodynamic flow of gases, diffusivity of gases and vapors, permeation mechanism in packaging materials, factors affecting permeability, permeability of multilayer structure, application of permeability for shelf-life estimation. 4h
  - Quality control and standards. 1h
  - Shelf life of packaged food- indices of quality failure of packaged food, factors affecting shelf life of packaged food,  $a_w$  and shelf life, mathematical modeling of prediction of shelf-life of packaged food, shelf-life determination, assignments & case studies. 3h
  - Packaging waste management options and methods of waste management. 2h

### References

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**Course Title:** Food Packaging

**Level:** M.Tech. (Food)

**Semester:** III

**Course No:**MFT 601B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

**Contents**

- Tests of appearance, strength and barrier properties of packaging materials.
- Performance evaluation of transport packages.
- Exercises on package designing to meet product needs for protection.
- Exercise on active packaging, antimicrobial packaging, protective edible coating, modified atmosphere packaging.
- Permeability studies.
- Shelf life testing and exercise on prediction of shelf life of pre-packaged products.
- Industry visits

**Course Title:**Food Storage Technology

**Level:** M.Tech. (Food)

**Semester:** III

**Course No:** MFT 602A

**Credit:** 3

**Nature of Course:** Theory

Full Marks: 75

Pass Marks: 37.5

**Course Description and Objective:**

The course provides deeper and wider understanding of the principles and the modern practices of food storage. Modern perception of saving food from loss and safety associated with the use of pesticides and course deals with storage of grain and its products. After harvest and this course make the students familiar in modern trend of food storage and their design or application such as silo design and their application and other alternative method of grain storage like air tight storage, aerated storage, CA, MA etc. Justified food storage techniques have been given due importance in this course.

**Contents**

- Over-view onpost-harvest losses and measurement. 2 h
- Factors affecting the shelf life of food commodities: 3 h
  - a. Physical & Thermal properties of grain.
  - b. Physico chemical properties of grain.
  - c. Biological properties of grain.
- Bio-chemical, functional and nutritive changes during storage: a. Respiration b. bio-chemical changes of carbohydrate, Nitrogenous Components, lipids c. nutritive changes, dorminancy and viability d. functional changes in wheat, corn, rice , barley, millets. 4h
- Pretreatment of food grain and seed before storage: cleaning and drying. 2 h
- Whole grain and processed products storage system: 12h
  - Modern bag storage system.
  - Modern silo storage system: silo and storage structure design; flow criteria, mass flow and funnel flow, discharge rate, static and dynamic loads and their distribution, Rankin's equation, Airy's equation Janssen's equation design of deep bin.
  - Airtight storage system, dry grain, damp grain, practical consideration of airtight storage system.
  - Applications of aerated, CA, MA storage and damp grain storage with chemical.

- Mycotoxin, determination and control. 4 h
  - Mycotoxigenic fungi and storage condition.
  - Aspergillasmycotoxin.
  - Penicilliummycotoxin
  - Fusariummycotoxin
- Infestation detection and monitory technique. 2 h
- Integrated pest management: background, concept and application in food storage system. 2 h
- Organic food : concept, processing and marketing. 2 h
- Advances infestation control techniques: sterility, attractants, repellents, antifeedants nutritional control and control by hormonal imbalance of stored pests insects. 4h
- Food Security system and Food storage. 2h
- Present status of irradiation of grains, seeds fruits and vegetables. 2h
- Safety aspect of pesticides and quality assurance of treated food. 2h
- International legislation pertaining to infestation control, storage and distribution of materials. 2h
- Environmental impact studies: soil, water, air and Food materials in food chain with bio-magnification and accumulation. 3h

### **References**

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**Course Title:**Food Storage Technology

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**M FT 602B

**Credit:** 1

**Nature of Course:** Practical

Full Marks: 25

Pass Marks: 12.5

### **Contents**

- Measurement of properties of food commodities: physical, chemical, biological, thermal, electrical, etc.
- Field study to assess loss of grains, fruits and vegetables during preparing harvesting, transportation, storage and distribution.
- Detection and qualification of mycotoxin in infested grains, oil-seed and nuts
- Development of model storage structure.
- Bulk fumigation of cereals, oil seeds and retail-packed processed food and assessment of effectiveness.
- Storage/warehouse design.
- Experiment related to flow of grain angle of repose, load calculation in lab scale silos.
- Exercise on selection and design of storage structure.
- Measurement of radiation level of differed raw and processed food.
- Detection of infestation level.
- Measurement of pesticides residence in treated food.
- Project work on grain storage system, food security, IPM and organic farming etc.
- Visit to modern storage system and report writing.

**Course Title:** Applied Statistics

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** M FT603A

**Credit:** 3

**Nature of Course:** Theory

Full Marks: 75

Pass Marks: 37.5

**Course Description and Objective:**

After completion of this course, the students will be able to i) make use of appropriate significance tests, ii) design and analyse the statistical experiments and iii) take advantage of quality control and life testing methods, for manufacturing, products and food quality issues. Good knowledge of descriptive statistics, basic probability, sampling theory and skills of using statistical software are prerequisites of the course.

**Contents**

• **Parametric and non-parametric significance tests**

- Estimation and basics of significance test (review): Definition of statistical estimation and test of significance, importance of estimation and test of significance in food science data, two types of error in inference, theory of hypothesis testing along with estimating confidence intervals. 4h
- Parametric hypothesis tests (revision with large and small sample): Test of significance i) for single proportion, ii) for difference between two proportions, iii) for single population mean, iv) of difference between two independent sample means, v) of sample means before and after some treatments used, vii) for sample correlation coefficient and viii) for equality of two variances. 6h
- Non-parametric (NP) hypothesis tests: difference between parametric and NP tests, needs of NP tests for food science problems; some NP Tests: run Test, sign Test, Median test, Mann -Whitney U test, Kruskal- Wallis H test; chi square test for i) goodness of fit and ii) independence of attributes. 6h

**2.Design of experiments and ANOVA**

- (a) Analysis of variance (Review): Introduction, its need, assumptions, ANOVA of one-way and two-way classifications, Test of overall significance of the regression coefficients; Post-hoc tests: importance, types and use. 4h
- (b) Design of experiments: Meaning and interpretation of DOE, Needs of DOE in laboratory works, principles of experimentation; Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD) with ANOVA; Concept and analysis of Taguchi's Parameter design. 7h
- (c) Factorial Designs: Concepts, principles; Two-factor and three-factor experimental designs, Analysis of  $2^2$ ,  $2^3$  and  $3^2$  designs; Confounding in  $2^3$  factorial design. 5h

**3.Quality control and life testing**

- (a) Control charts: Review of the characteristics of basic control chart (x-bar, R, s, c and np); OC curve, performance measurement of x-bar chart using OC; Process capability, modified control charts, acceptance sample size and control chart. 5h



(b) Acceptance sampling plan: acceptance quality level (AQL) and limiting quality level (LQL), lot by lot acceptance plan, single and multiple sampling plan, computation of acceptance probability, consumer's and producers' risk (calculation) for both plan, construction of OC curves for single and double sampling plan; average outgoing quality (AOQ) and average sample number (ASN). 7h

(c) Life testing methods: Concepts of reliability, failure function, hazard function and survival function, mean time to failure; life testing using exponential model: estimating failure rate, survival time and mean life time of the product. 4h

## **References**

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**Course Title:**Industrial Management

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 604A

**Credit:**2

**Nature of Course:** Theory

Full Marks: 50

Pass Marks: 25

**Course Description and Objective:**

The main objective of the course is to make the students aware of the modern concept of management system in the food industries. The course helps in developing managerial skills such as, planning, organizing, delegating of authority, motivation, leadership, decision making and control. The objective of the course is to activate the function in which various administrative tasks are carried out and skill is used in carrier to achieve desired results.

1) Principles of Management: Introduction, Definition of management, Characteristics of management, Functions of management. 2h

• **Corporate Management** 10h

- Corporate management: Concept, nature, purpose and functions, levels and types of managers, managerial skills and roles, evolution of management thoughts (classical, behavioral, decision and management theory).
- Planning: Brief description of planning, nature of planning, steps of planning process, objective.
- Organizing: Brief orientation on the organization structures, formal and informal organizations, principles of organizations (chain of command, span of control, delegation, decentralization, empowerment), forms of organizational structure (Traditional and modern), delegation of authority (Principle, feature, process, importance), centralization and decentralization of authority and factors affecting decentralization of authority.
- Leadership: Concept, qualities and styles of leadership.
- Organizational conflict: Meaning, types, sources and managing conflict in the organization.
- Global context of management: Concept of globalization, method and effect. Multinational companies (meaning, types, merits and demerits)
- Motivation: Concept, process, theories, reward system and methods of motivation

**3) Marketing Management** 8h

- Marketing: concept and conceptual development of marketing, nature and role.

- Marketing management: concept and conceptual development of marketing management and elements, trends in marketing management, aspects of marketing process and adoption of marketing management, consumer analysis, customer value and satisfaction and cost of customers lost, promotion mix management.
- Managing marketing opportunities: Identifying and selecting markets, evaluations and selection of markets, analyzing and evaluating market opportunities The basics of designing market strategies; marketing planning programs building, market plan, contents of marketing plan, marketing mix, forecasting market demand.
- Management of product life cycle: General introduction to classification of products, meaning and premises of product life cycle, management of the product life cycle strategies, characteristics of a product, branding, packaging.
- Competitor analysis: Concept of competition, price and non – price competition, building competitor related strategies.
- Management of price: Selection of pricing objectives and pricing method.
- The importance of value chains in the agri-food sector.

#### **4) Financial management**

5h

- Overview, capital structure, fixed & working capital,
- Basic dimension of financial decision making (risk and returns);
- Financial planning and analysis of financial statements (including Break even analysis - assumptions, importance, cost-benefit analysis);
- Capital budgeting;
- Cash management (theory, planning, and control);
- Cash flow statement
- Corporate liquidation

- **Human resource management**

5

- importance, planning, recruitment and selection, training
  - Management development: concept, goals and method, job evaluation
  - Industrial relations

- **Overview of the production operation system**

2h

## References

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**Course Title:** Fruit and Vegetable Technology- II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 606A

**Credit:** 3+1\* (1\*= Seminar)

**Nature of Course:** Theory

Full Marks: 100

Pass Marks: 50

**Course Description and Objective:**

The course is designed in processing aspect of major fruits and vegetables of Nepal. These are given a special attention because orange/mandarin, mango, apple and pineapple are major fruits and tomato & potato are a major vegetable in Nepal. This course provides intensive knowledge of post-harvest physiology, preservation and processing of major fruits and a vegetable and stimulates food technologists for research in this area.

**Contents**

**• Tomato** 8h

Maturity stages, procurement, pack house operations, composition, pectic enzymes in tomato ripening, effect of maturity on chemical characteristics, storage of tomatoes, grading, tomato ripening procedure, tomato juice concentrates, changes during storage of tomato concentrates, effect of thermal treatment on tomato puree quality, different tomato drying methods, Frozen storage of tomato puree, hot water treatment of tomato, quality of hot- and cold-break tomato juices, effect of enzyme treatment of volatile contents of tomato pulp, thermal and high pressure inactivation of pectic enzymes.

**• Potato** 5h

Botany, cultivar,commercial varieties, Nepal and worlds production,maturity and harvesting, composition, nutritive values, storage, potato products (powder, granules, chips, sticks, potato flakes, frozen potato, dehydrated mashed potato, canned potatoes, potatoes starch and other miscellaneous potato products).

**3. Apple** 7h

Maturity and soundness, composition, apple juice and concentrates, different types of apple juices, quality of apple juice as influenced by processing operations and heat treatment.

application of enzymes in juice preparation, post-bottling hazes, fraud in apple juice industries, apple juice enhancement, juice extraction by DDS method, optimum ripening procedure, postharvest treatments.

**4. Mango** 4h

Commercial varieties, maturity, essential quality attributes, composition, pack-house operation, problems and remedy while packing mangoes, pre-and post-harvest treatments, ripening of mangoes, techniques of delaying mango ripening, storage of mangoes, grading, mango processing, mango concentrates.

## 5. Pineapple

4h

Commercial varieties, maturity, composition, processing of pineapples, grading of pineapple juice and canned pineapple, juice enhancement.

## 6. Oranges and mandarin

13h

Production; botany; origin; commercial cultivars, composition; maturity criteria and harvesting ;fruit quality for processing; methods of preservation; preparation for processing; methods of juice extraction and types of juice extractor; post extraction operation for the production of concentrated juice; effects of processing on juice quality, evaporators for concentration (TASTE), production of single strength orange juices, powdered orange juice; freeze dried juice; enzymes and their application, essence recovery; bitter principles and its removal from the juice, flavor components in orange juice and their stabilization;

## 7. Byproduct utilization and waste management

5h

Yields%, composition and nutritive values of different fruits and vegetable byproducts; edible and inedible byproducts; preparation of pectin, vinegar, alcohol, candy, essential oil, seed oil, citric acid, jelly and other non food products from by-products and wastes and effluent treatment of fruits and vegetable industry.

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**Course Title:** Fruit and Vegetable Technology –II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT606B

**Credit:**2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Contents**

- Determination of crude fiber, alcohol insoluble solid, and ascorbic acid as indices of post-harvest maturity
- Ripening of fruits using ethylene
- Isolation and characterization of pectin from orange peel or other fruits
- Extraction of orange peel oil from orange peel
- Extraction of color pigments from different fruits and vegetables
- Extraction and characterization of papain from papaya fruit and tree
- Detection of adulteration in fruit juices
- Project work: work on fruit and vegetable industry problem
- Preparation of products from different fruits and vegetables.
- Product preparation from fruits and vegetable byproducts



**Course Title:** Meat Technology II (Product Technology)

**Level:** M.Tech. (Food)

**Semester:** III

**Course No:** MFT607A

**Credit:** 3+1\*(1\* = Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

**Course Description and Objective:**

The course provides to students with extensive description of manufacturing process of different industrially important meat products. Raw materials, processing aids, processing equipment, product manufacturing process, packaging and storage are general contents for every product. Each of these contents will be extensively dealt with. Also, the latest advances in technology are included. The course focus is on product quality and so all factors that may have effect on product quality are properly discussed. Spoilage is another aspect to be cared. Class seminars are conducted with objective to strengthen the theoretical knowledge gained by students in class and widen their outlook about meat technology. Self-study assignment of important topics to students, presentation of emerging trends by students on assigned topics, and intensive group discussion will constitute the class seminar. Basic knowledge about meat processing technology is prerequisite for this course.

**Contents**

- Technology of meat products

Technology of following processed meat products is provided:

Coarse ground sausage, emulsion type cooked sausage, pre-cooked sausage (e.g. liver sausage, blood sausage, liver pâté, meat jelly), raw sausage (fermented, dry, semi dry type), cured meat (ham, bacon, etc), cooked cured meat (cooked ham, Lachshinken, etc), canned meat products, shelf stable type sausage and meat, organic meat products, other meat products (restructured meat, burger, meat patty, crumbed products, meat pie, liver pâté, meat pickle).

The contents for the technology of above processed meat products are:

production process feature; product type and classification; Selection of proper raw material (quality of meat and fat); checking the quality of raw material; Type, properties, functions and dose of processing aids; general manufacturing process (objective and process detail of all processing stages); physical, chemical and biochemical changes during processing; different manufacturing technologies; formulation and process outline for individual product type; type, construction, function, working and operation of processing equipment; process mechanization and automation; process programming and control; recent and future trends; desired product quality attributes, quality grades and defects; factors influencing product yield and quality; type of influence on yield and quality

36h

- Packaging, storage, transportation: type of packaging materials, retail packaging and shipping containers, properties and functions of packaging materials and packages, type of storage, type of transportation, type of hazard.

4h

- Spoilage, safety and shelf life aspects of processed meat products: type of spoilage, cause of spoilage, microorganisms and chemicals of safety concern, prevention, factors affecting shelf life. 4h
- By-product processing and waste management: meat by-product processing and waste management: processing and upgrading of animal blood, fatty tissue, bone, hide, skin and viscera; production of meat extract and mechanically separated meat; processing of inedible by-products, management of solid waste and effluent 6h
- Class seminar: topics for class seminar are functional meat products, reduced salt products, synthetic meat products, nitrite free products, intelligent packaging of meat, recent and future trends in meat processing, industry organization related topics, etc. 16h

### **References**

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**Course Title:** Meat Technology – II (Product Technology)

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT607B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Course Description and Objective:**

- Provide hands-on training to students on the preparation and analysis of different processed meat products.
- Build skill and capability in students to produce, analyze and evaluate the products independently by means of lab based project work.
- Provide knowledge on design, layout and costing of meat production facilities.
- Acquaint students with production related problems and provide idea for trouble shooting.

**Contents**

- Preparation of meat products: cooked sausage, pre-cooked sausage, bacon, ham, fermented dry sausage, cooked cured meat, fresh coarse type sausage, canned meat, liver sausage, blood sausage, meat burgermeasurement of density, Eh of sausage products.
- Qualitative and quantitative test for salt, phosphate, starch, plant protein in sausage products.
- Sensory evaluation of prepared products: grading, acceptance test (hedonic rating), discrimination test, descriptive rating, fault findings.
- Exercises on feasibility study, drawing, design, layout and costing of slaughterhouse and meat processing plant.
- Project work on production, packaging, storage, sensory and chemical analysis, costing of meat products and report preparation.
- By-product processing.
- Visit and report writing about meat industries.

**References**

- Leo M. L. Nollet (ed.). (2007). Handbook of Meat, Poultry and Seafood Quality. Blackwell Publishing.
- Subba, D. (2001). Practical Book of Meat, Poultry and Fish Technology. Royal Nepal Academy of Science and Technology, Khumaltar, Lalitpur.

**Course Title:** Grain Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT 608A

**Credit:** 3+1\*(1\*= Seminar)

**Nature of Course:** Theory

Full Marks: 100

Pass Marks: 50

**Course Description and Objective:**

The course provides the student advance of barley grain technology for food feed and industrial uses, millet, sorghum and buckwheat milling and utilization. This course also provided the advance pulses milling utilization, seed processing technology, flour strength, dough testing, baking technology, pasta and instant noodles preparations and their quality. It is expected that after completing this course student individually can handle and solve the problem related to minor grain processing and utilization flour strength and dough testing and baking technology pasta and instant noodles technology.

**Contents:**

- Barley grain technology: Milling & utilization of barley, processing of barley for food & feed, malting of barley grain for food uses, size reduction processing of barley grain, malting of barley for brewing purposes. 6h
  - Other grain technology: Milling & utilization of millet, sorghum & buckwheat. 5h
  - Modern Pulses milling: Nutrition modern method of pulses milling and technology, utilization of pulses, problems. 4h
  - Dough testing & baking: Strength of flour, rheology of dough, dough testing and instrumentation, farinography, mixography, extensography & amylography/rapid visco analyzer etc. 8h
  - Technology for the manufacture of bakery products bread, biscuits, cakes and the effect of variation in formulation and process parameters on the quality of finished products, quality parameters & machineries used in bakery industry. 12h
  - Pasta and Instant Noodles: Raw materials and their qualities, processing technology and product quality control, management and packaging. 4h
  - Seed process technology: Modern method of seed processing technology (cleaning, upgrading, drying treatment, packaging & storage). 6h
  - By-product of grain pulses utilization and waste management in cereal processing industry. 3h
- Seminars** 16h

- Different barley food preparation, processing and development, changes in composition of barley by processing barley food & public health.
- Utilization of naked barley, amaranth, oats, rye triticale, buckwheat, millet, sorghum & study their health effect.
- Effect of mixing method, time on the rheological characteristics of dough.
- Utilization of pulses, nutritional and anti nutritional factors.
- Different formulation, product development & volume addition of baked products.
- HACCP of pasta and instant noodles value addition, texture and cooking quality.

### **References**

- Williams A. (1975). Bread Making the Modern Revolution , Hutchinson Bentam London.
- Kent Jones, D.W.& Omos, A.J., (1967). Modern Cereal Chemistry, Food Trade Press, London.
- Manley D. (2000). Technology of Biscuits Crackers, Cookies, 2nd Edition. CRC Press
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- R. Shewry and Steven E. Vllrich, Barley Chemistry and Technology, 2<sup>nd</sup> Edition, American Association of Cereal Chemists. Minnesota, USA.
- Agarwal, R.L. (1980). Seed Technology, Oxford IBH Publishing, New Delhi.

**Course Title:** Grain Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT 608B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

### **Contents**

- Preparation of barley malt for food & brewing purposes & quality evaluation.
- Preparation of buckwheat flour & grits and quality analysis.
- Preparation of millet & sorghum flour and quality.
- Pulses milling design of plant and product quality.
- Determination of nutritional and anti- nutritional factors.
- Testing of dough and different baking purposes.
- Determination of strength & water absorption capacity of dough by different method.
- Experiment of baking & project work on bakery and biscuits industry.
- Preparation, quality determination and value addition of pasta and instant noodles.
- Determination of texture and cooking quality of pasta and instant noodles.
- Experiment in seed processing & testing.
- Visit to study bakery, biscuits, pasta & noodles and seed processing plants.

**Course Title:** Dairy Technology-II(Technology of Dairy Products)

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT 609A

**Credit:** 3+1\*(1\*= Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

### **Course Description and Objective:**

Dairy technology-II aims to provide knowledge on the production and quality control of a wide range of milk products, ranging from fermented milk, cheese, ice cream to milk powders. Since fermented milk products and cheese have been given greater emphasis in this course, a brief discussion on starter culture technology is in order. Dairy industry is the single-most largest user of processing water and consequently the largest producer of effluent. A chapter on waste treatment and by-product utilization (valorization), which applies also to dairy technology-I, is therefore included in this course.

### **Contents**

- **Dairy product range:** Overview. 1h
- **Cheese:** Introduction, principles of cheese making, classification schemes; ingredients and their quality; starter culture; rennet and its role in cheese-making; milk pretreatments for cheese making; ripening of cheese; factors affecting cheese quality; trouble-shooting (no curd or weak curd); production of cheddar, mozzarella, cottage, kanchan, processed, and yak cheese; cheese defects, causes and prevention. 11h
- **Cream:** Introduction, types, manufacturing details, physical structure (formation and stability). 3h
- **Ice cream:** Introduction, classification, composition, ingredients, formulation, manufacture, defects, quality control and analysis. 8h
- **Butter:** Introduction, classification, principles of butter making, manufacture of different types of butter by batch and continuous process, butterfat crystallization and its implication in butter quality, quality control and analysis. 4h
- **Ghee and anhydrous milk fat:** Introduction, classification, manufacture (different methods), quality control and analysis, tests for adulteration, grading and standards. 4h
- **Milk powder:** Introduction, production of milk powder (different types) by different methods (roller/drum, spray drying), instant milk powder production, powder milk quality control and analysis. 5h

- **Dairy by-product utilization:** Introduction, co-product and by-product recovery and utilization (whey and lactose, buttermilk). 7h
- **Dairy plant management and dairy effluent treatment:** Elements of dairy plant management, process and operations strategies, product design, process selection, automation, process planning, facility location, plant layout.
- **Seminar.** 16h

## References

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- Weinstein, B. (1999). The Ultimate Ice Cream Book. HarperCollins Publishers, Inc., Australia.

**Course Title:** Dairy Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT609B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Course Description and Objective:**

This practical course aims to provide students hands on skill in the preparation and quality analysis of different dairy products. A short visit to nearby dairy plant will familiarize students with industry-level processes and effluent treatment facilities.

**Contents**

- Prepare different cheese types: cottage cheese, mozzarella, processed cheese, paneer.
- Quality analysis of milk products: ice cream, yogurt, butter, ghee, paneer, cream, milk powder and cheese.
- Preparation of condensed milk using vacuum evaporator.
- Preparation of ice cream.
- Preparation of yogurt.
- Field visit to nearby cheese factory.

**Course Title:** Tea and Coffee Technology-II

**Level:** M.Tech. (Food)

**Semester:** III

**Course No:**MFT 610A

**Credit:** 3+1\*(1\*= Seminar)

Full Marks: 100

**Nature of Course:** Theory

Pass Marks: 50

**Course Description and Objective:**

The course provides deeper and wider understanding of tea and coffee technology. Legislations, safety aspects, organic certifications, ISO certifications and specialty tea and coffee are discussed broadly along with the sustainable development and contemporary researches. The course focus is on quality assurance, advancement and local technology of tea and coffee.

**Contents:**

- **Quality evaluation of tea and coffee.** 8h  
Factors affecting tea and coffee quality, cup testing and sensory evaluation techniques, objective methods of analysis of flavor compounds in tea and coffee, biochemist's view in tea and coffee quality.
- **Quality assurance and detection of adulterants in tea and coffee** 6h
- **Legal aspects, quality standards and specifications of tea and coffee**
- **Organic tea and organic coffee** 5h  
Evolution, introduction, polyphenolic constituents, methods of extraction of polyphenolic constituents; functional components, anti-oxidative action of tea and coffee polyphenols, organic certifications.
- **Advances in tea and coffee technology.** 15h  
Product diversification, use of tea and coffee in other food products and related beverages, tea blends, tea concentrates, decaffeinated tea, flavored tea (spiced and herbal tea), tea bags, tea tablets; blending of coffee with chicory, soluble coffee, espresso coffee, decaffeinated coffee, monsooned coffee, coffee brew concentrate, value addition; ISO certifications, mechanization and food safety aspects in tea and coffee industry, tea and coffee pharmacology-medicinal values of different types of tea and coffee, contemporary research and improved technology.
- **Specialty tea and coffee in Nepal.** 5h  
Technology of specialty tea (Pearl, white, red, yellow, blue, brown, iced, lappet tea/pickled etc) and technology of specialty coffee (roasted bean coffee brew, espresso etc.).
- **Contemporary issues in tea and coffee technology.** 3h  
Approach to sustainable development, tea and coffee tourism, economics.
- **By-products utilization and waste management in tea and coffee.** 1h
- **Seminar** 16h  
Status of organic tea and coffee in Nepal, Nepalese specialty tea in the world, role of tea and coffee in biodiversity, ISO 9000, ISO 22000 and ISO 14000 certification in tea and coffee factories, tea and coffee tasters, loopholes and need of improvements in tea and coffee legislations, local case study related to tea and coffee safety, document development for HACCP application for tea and coffee production, recent

and future trends in tea and coffee processing, industry organization related topics, etc.

## **References**

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**Course Title:** Tea and Coffee Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT 610B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Contents**

- Cup testing of tea and coffee and statistical analysis.
- Preparation of ready mix tea and coffee beverages.
- Preparation of fortified tea and coffee beverages.
- Preparation of decaffeination of tea and coffee.
- Preparation of cappuccino and latte coffee.
- Preparation of some specialty teas.
- Preparation of flavored tea (herbal and spiced).
- Detection of adulterants, and test of pesticide residues in tea and coffee.
- Visit to the specialty tea and coffee manufacturers.

**Course Title:**Technology of Alcoholic and Non-alcoholic Beverages -II

**Level:** M.Tech. (Food)

**Semester:** III

**Course No:** MFT611A

**Credit:** 3+1\*(1\*= Seminar)

Full marks: 100

**Nature of Course:** Theory

Pass Marks: 50

### **Course Description and Objective:**

The following course intends to impart theoretical and practical knowledge on the technology of alcoholic and non-alcoholic beverages. The term 'beverages' has been contextually reserved of liquid drink other than water. Tea, Coffee and similar products that are not available as liquid have been excluded from this course, after the completion of this course, the students will gain theoretical and practical knowledge on the technology of carbonated, non alcoholic beverages and distilled alcoholic beverages and be able to carry out quality control and analysis of alcoholic and non-alcoholic beverages.

### **Contents**

#### **1: Carbonated beverages**

General: introduction, classification, production statistics

Water treatment: water quality (requirement), treatment, factory water systems

Ingredients: sweeteners (bulk and artificial), acidulants, carbon dioxide, flavoring, colors

Production: formulating, syrup preparation and syrup room operation, pasteurization, carbonation and filling

Unitization system: concept, unit design, outsourcing the unitization operation

Quality control: quality control blocks, outsourcing and quality rating system

Waste treatment: review of different waste treatment systems used in carbonated soft drink

#### **2: Ethanol production**

Molasses-based fermentation: batch and continuous fermentation

Cellulose-based fermentation: substrate Pretreatment methods, fermentation

Distillation: batch and continuous, rectified spirit, dehydrate alcohol

Waste treatment: review of different waste treatment systems used in distillation and fermentation industries.

#### **3: Congeneric and non-congeneric products**

Whisky, brandy and rum: introduction, classification, production

Gin and vodka: introduction, classification, production

Blending: principles of blending

Quality control: physicochemical and sensory quality analysis of different products

## References

- Alan H. Varnam and Jane P Sutheland (1994). Beverages: Technology, Chemistry and Microbiology. Springer Science, New York
- Ananda S. Amarasekara (2014). Handbook of Cellulosic Ethanol. John Wiley & Sons, New Jersey.
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**Course Title:**Technology of Alcoholic and Non-alcoholic Beverages - II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT611B

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Contents**

- Physicochemical analysis of water
- Microbiological analysis of water
- Exercise on use of spreadsheet template for formulation
- Formulation of carbonated soft drink ( cola and non-cola)and analysis
- Inoculums build-up for alcohol fermentation
- Production of ethanol from molasses and other materials
- Preparation and analysis of rum and brandy
- Statistical analysis of sensory data



**Course Title:** Snacks Food Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 562A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Snack Food Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 562B

**Credit:** 2

**Nature of Course:** Practical

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Spices and Herbs Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 563A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Spices and Herbs Technology-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 563B

**Credit:** 2

**Nature of Course:** Practical

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Technology of fat and oil-II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 564A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:**Technology of fat and oil -II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:**MFT 564B

**Credit:** 2

**Nature ofCourse:** Practical

Full marks: 50

Pass Marks: 25

**Course will be developed later**

**Course Title:** Sugar Technology -II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 565A

**Credit:** 3+1\*(1\*=Seminar)

**Nature of Course:** Theory

Full marks: 100

Pass Marks: 50

**Course will be developed later**

**Course Title:** Sugar Technology - II

**Level:**M.Tech. (Food)

**Semester:** III

**Course No:** MFT 565B

**Credit:** 2

**Nature of Course:** practical

Full marks: 50

Pass Marks: 25

**Course will be developed later**



**Level:**M.Tech. (Food)

**Semester:** III

**Course Title:** Project Work

**Course No:**MFT605A

**Credit:** 2

**Nature of Course:** Practical

Full Marks: 50

Pass Marks: 25

**Course Description and Objective:**

Project work increases the self involvement of students in learning and problem solving in his/her subject relevant area thus increasing their problem solving ability. In this course student learn scientific proposal writing, report writing and presentation skill of research.

Project will be experimental type with not more than 3 students per group. Department will provide the topic for project work. Students must present the project report as per dissertation format.The nature of the project work is experimental /field based and evaluation of project is decided by the department.

# Semester - IV

**Course Title: Dissertation**

**Course No:MFT651**

**Credit: 8**

**Nature of Course:**

Full Marks: 250

Pass Marks: 150

**Course Description and Objective:**

The objective of this course is to develop ability in students to write a research proposal, design and conduct a sound research work and present the important parts of the research in standard scientific writing format. This is dissertation in natural science discipline. Students will spend whole of a semester time on doing a dissertation by research independently on a topic decided by the department. Students carry out the work under the supervision of a faculty assigned by the department. The department will notify in time the necessary prescription and work schedule. The research work must prove its novelty, scientific merit and significance to the field of work. The amount of work done and the inputs given must justify the credit hour allotted for dissertation and total working days allotted for a semester.