

# **FACULTY OF SCIENCES**

## **SYLLABUS**

**for**

### **B.TECH. (FOOD TECHNOLOGY)**

**(Under Credit Based Continuous Evaluation Grading System)**

**(Semester: I - VIII)**

**Examinations: 2016–17**



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## **GURU NANAK DEV UNIVERSITY AMRITSAR.**

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**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
(Credit Based Continuous Evaluation Grading System)

**FIRST SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-102	C	Manufacturing Processes	3	1	-	4
FTL-103	C	Grain Handling and Storage Technology	2	-	-	2
FTL-104	C	Principles of Food Preservation	3	-	-	3
CYL-195	C	Engineering Chemistry	2	1	-	3
ENL-101	C	Communicative English	2	-	-	2
PBL-121 or PBL-122	C	Punjabi Compulsory or ਮੁੱਢਲੀ ਪੰਜਾਬੀ (Basic Punjabi)	2	-	-	2
FTP-121	C	Manufacturing Processes	-	-	2	2
FTP-122	C	Principles of Food Preservation	-	-	2	2
CYP-196	C	Practical Chemistry	-	-	2	2
<b>Total Credits:</b>			<b>14</b>	<b>2</b>	<b>6</b>	<b>22</b>

**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
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**SECOND SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-152	C	Thermal Science	3	1	-	4
FTL-153	C	Food Chemistry	3	-	-	3
FTL-155	C	Applied Mathematics	3	1	-	4
ENL-151	C	Communicative English	2	-	-	2
PBL-131 or PBL-132	C	Punjabi Compulsory or ਮੁੱਢਲੀ ਪੰਜਾਬੀ (Basic Punjabi)	2	-	-	2
FTP-172	C	Food Chemistry	-	-	2	2
FTP-173	C	Engineering Graphics and Drafting	-	-	3	3
ID-1	I	Interdisciplinary (ID) course	-	-	-	-
<b>Total Credits:</b>			<b>13</b>	<b>2</b>	<b>5</b>	<b>20+ID</b>

**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
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**THIRD SEMESTER**

Course No.	C/E/I	Course Title	Credi			Total
			L	T	P	
FTL-201	C	Basic Food Engineering	3	1	-	4
FTL-202	C	Basic Microbiology	3	-	-	3
FTL-203	C	Food Hygiene and Sanitation	3	-	-	3
FTL-206	C	Sugar Processing and Refining	3	-	-	3
*ESL-220	A	Environmental Studies (Compulsory)	3	-	-	3
ECL-210	C	Basic Electrical and Electronics Engineering	3	1	-	4
FTP-221	C	Basic Microbiology	-	-	2	2
FTP-224	C	Sugar Processing and Refining	-	-	2	2
ID-2	I	Interdisciplinary (ID) course	-	-	-	-
<b>Total Credits:</b>			<b>18</b>	<b>2</b>	<b>4</b>	<b>24+ID</b>

**\*Note: Credits will not be included in the Grand Credits**

**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
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**FOURTH SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-252	C	Cereals and Legumes Technology	3	1	-	4
FTL-253	C	Fruits and Vegetables Technology	3	1	-	4
FTL-254 OR FTL-258	E	Industrial Microbiology OR Sugar Industry Co-Products	3	-	-	3
FTL-255	C	Fluid Flow and Heat Transfer	3	1	-	4
FTL-256	C	Mechanical Operations	3	1	-	4
FTP-271	C	Cereals and Legumes Technology	-	-	2	2
FTP-272	C	Fruits and Vegetables Technology	-	-	2	2
FTP-273 OR FTP-276	E	Industrial Microbiology OR Sugar Industry Co-Products	-	-	2	2
FTP-274	C	Mechanical Operations	-	-	2	2
<b>Total Credits:</b>			<b>15</b>	<b>4</b>	<b>8</b>	<b>27</b>

**For elective courses:** The students can opt **any one** combination from the following:

Combination 1: FTL-254 + FTP-273 (Industrial Microbiology)

**OR**

Combination 2: FTL-258 + FTP-276 (Sugar Industry Co-Products)

**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
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**FIFTH SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-301	C	Dairy Technology	3	1	-	4
FTL-302	C	Fish, Meat and Poultry Technology	3	1	-	4
FTL-303	C	Fats and Oil Technology	3	-	-	3
FTL-306	C	Mass Transfer	3	-	-	3
FTL-307	C	Computer Applications in Food Industry	3	1	-	4
FTP-321	C	Dairy Technology	-	-	2	2
FTP-322	C	Fish, Meat and Poultry Technology	-	-	2	2
FTP-323	C	Fats and Oil Technology	-	-	2	2
FTP-326	C	Computer Applications in Food Industry	-	-	2	2
ID-3	I	Interdisciplinary (ID) course	-	-	-	-
<b>Total Credits:</b>			<b>15</b>	<b>3</b>	<b>8</b>	<b>26+ID</b>

**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
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**SIXTH SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credit
			L	T	P	
FTL-351	C	Food Regulations and Quality Control	3	1	-	4
FTL-352	C	Applications of Enzymes in Food Industry	3	-	-	3
FTL-353	C	Biochemical Engineering	2	-	-	2
FTL-354	C	Packaging Technology	3	1	-	4
FTL-357	C	Human Resources Management in Food Industry	3	-	-	3
FTP-371	C	Food Regulations and Quality Control	-	-	2	2
FTP-372	C	Biochemical Engineering	-	-	2	2
FTP-373	C	Packaging Technology	-	-	2	2
<b>Total Credits:</b>			<b>14</b>	<b>2</b>	<b>6</b>	<b>22</b>

**B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)**  
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**SEVENTH SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-401	C	Food Process Engineering	3	1	-	4
FTL-402	C	Confectionery Technology	3	1	-	4
FTL-403	C	Spices and Flavour Technology	3	-	-	3
FTL-404	C	Food Processing Plant Layout and Design	3	-	-	3
FTP-421	C	Food Process Engineering	-	-	2	2
FTP-422	C	Confectionery Technology	-	-	2	2
FTP-423	C	Spices and Flavour Technology	-	-	2	2
FTP-424	C	Seminar and Group Discussion	-	-	2	2
ID-4	I	Interdisciplinary (ID) course	-	-	-	-
<b>Total Credits:</b>			<b>12</b>	<b>2</b>	<b>8</b>	<b>22+ID</b>



***B.TECH. (FOOD TECHNOLOGY) (SEMESTER SYSTEM)***  
 (Credit Based Continuous Evaluation Grading System)

**EIGHTH SEMESTER**

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTP-451	A	Industrial Training (6 months i.e. Jan-June)	-	-	20	20
<b>Total Credits:</b>			-	-	<b>20</b>	<b>20</b>

**For Course FTP-451:** Submission of Industrial Training Report along with Original Certificate.

**FTL-102: MANUFACTURING PROCESSES****Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

1. **Plastics and their Processing:** Introduction, Types of Plastics, Thermo-plastics, Materials for processing plastics, Moulding processes compression moulding, Transfer Moulding, Injection moulding, Extrusion, Calendering, Thermo forming, Blow moulding, Casting, Laminating and Reinforcing, foamed plastics, Fastening and machine plastics.
2. **Ferrous Metal and Alloys:** Introduction, Pig iron, cast iron, wrought iron, carbon steel, alloy steel, blast furnace, modern development, electric furnace process, classification of steel, unalloyed steels and alloy steels.
3. **Non-Ferrous Metals and Alloys:** Introduction, Aluminum and its alloys, copper and its alloys, lead and its alloys, phosphors Bronze gun metal.
4. **Joint Processes:** Introduction, weldability, types of welding, welding processes, use of electricity in welding, formation and characteristics of electric Arc, Four positions of Arc, welding, types of joints and types of applicable welds, Arc. Welding machine. TIG welding MIG welding, submerged welding, laser welding, spot welding etc. gas welding, Oxyacetylene welding, types of gas flame welding equipments, relative merits of AC and DC welding, welding defects, soldering and Brazing. Welding technique for Pipes.

**UNIT-II**

5. **Carpentry:** Introduction, structure of wood, grain in wood, seasoning of wood, classification of wood, common varieties of Indian timber, carpentry tools, marking and measuring tools, cutting tools, boring tools, striking tools, holding tools, miscellaneous tools, carpentry processes marking, sawing, planning, chiseling, boring, grooving, rebating, moulding, carpentry joints, wood working lathe, circular saw, band saw, wood planer, joint, mortiser.
6. **Foundry:** Introduction, pattern making pattern materials, types of pattern, solid pattern, split pattern, match plate pattern, three piece split pattern, etc. Pattern making allowances moulding tools and equipments. Moulding sand, types of moulding sands, properties of moulding sand casting defects.
7. **Mechanical Working of Metals (Metal Forming) :** Introduction, hot working, rolling, forging, piercing, Drawing, Spinning, extruding, cold working, metallurgical advantages of hot working over cold working processes.

### UNIT-III

8. **Machine Process:** Introduction, function of the lathe, types of lathe, speed lathe, engine lathe, bench lathe, tool room lathe, capstan and turret lathe, special purpose lathe, automatic lathe, size of lathe, list of lathe operations. Difference between Capstan and Turret and an Engine lathe.
9. **Drilling Machine:** Introduction, types of drilling machine, work holding devices, list of drilling machine operation, twist drill nomenclature.
10. **Shaper and Planning Machines:** Introduction, types of shaper and planner, list of shaper and planer operations, Planner vs shaper machine.
11. **Grinding Machines :** Introduction, kinds of grinding, types of grinding machines, rough grinding and precision grinding, portable and flexible shaft grinders, swing frame grinders, surface grinders etc. size and capacities of the grinder.

#### **Recommended Books :**

1. Workshop Technology by Hazra Chaudhary, Latest Edition, Volumes I, II
2. Workshop Technology by W.A.J. Chapman, Part I and II.

**FTL-103: GRAIN HANDLING AND STORAGE TECHNOLOGY**

**Credits: 2-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**Theory:**

**UNIT-I**

Principles of grain storage  
Grain storage structures  
Stored product pests- insects, rodents, fungi, their nature and occurrence

**UNIT-II**

Pest control- Techniques of pesticides application and fumigations  
Pesticide chemistry, their toxicology and residual analysis  
Pest control measures and sanitation of mills

**UNIT-III**

Grain procurement and handling  
Modern techniques of infestation control  
Pesticides and health hazards  
MAS / CAS, Hypobaric storage

**Recommended Books:**

- |                             |                               |
|-----------------------------|-------------------------------|
| 1. Pesticides and Pollution | by Mollan                     |
| 2. Systematic Fungicide     | by Marsh (1973)               |
| 3. Introduction of Insect   | by Metalf and Lukemann (1994) |
| 4. Pesticides Formulations  | by Woods.                     |

**FTL-104: PRINCIPLES OF FOOD PRESERVATION**

**Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

General introduction of food  
preservation Historical development in  
food preservation  
Characteristics of foods  
Causes of quality deterioration of foods and methods of its  
prevention  
Preparation of food for processing  
Canning

**UNIT-II**

Drying /dehydration, types of dryers  
Irradiations, sources and mechanism  
Pickling and fermented products  
Additives and chemical preservative  
Intermediate moisture foods

**UNIT-III**

Enzymes in Food processing  
Freezing and cold storage of foods, factors effecting freezing types of freezing and freezers  
Food packaging – rigid and flexible, corrosion of container  
Food Processing and mal–nutrition, restoration, enrichment, fortification and  
supplementation of foods

**Recommended Books:**

1. Food Science – Potter.
2. Technology of Food Preservation – Dessrosier and Dessrosier
3. A Complete Course in Canning – Lopez.
4. Preservation of Fruits and Vegetables – Girdhari Lal, Siddapa, Tandon. ICAR, New Delhi

**CYL-195: ENGINEERING CHEMISTRY**

**Credits: 2-1-0**

**UNIT-I**

**Water**

- Common Impurities of water
- Hardness of water: Determination of hardness by Clark's test and complex metric (EDTA) method, Degree of hardness.
- Numerical based on hardness and EDTA method
- Municipal water supply; Requisites of drinking water, Steps involved in purification of water, Sedimentation, coagulation, Filtration, and Sterilization, Break point chlorination.

**Water Treatment**

- Softening of water; Lime-soda method, Permutit (Zeolite) Method and Deionization or Demineralization Method
- Boiler troubles their causes, disadvantages and prevention: Formation of solids (Scale and Sludge), Carry over (Priming and Foaming), Corrosion and Caustic Embrittlement
- Numerical problems based on Lime-Soda and Zeolite softening methods

**UNIT-II**

**Cement**

- Definition, Composition, basic constituents and their significance, Manufacturing of Portland cement by Rotary Kiln Technology
- Chemistry of setting and hardening of cement and role of gypsum

**Glass**

- Definition, Properties, Manufacturing of glass
- Types of silicate glasses and their commercial uses
- Importance of annealing in glass making

**Refractories**

- Definition, classification, properties, Requisites of good refractory and manufacturing of refractory
- Detailed study of silica and fire clay refractory and their uses
- Seger's (Pyrometric) Cone test and RUL Test

**UNIT-III**

**Polymers**

- Different methods of classification and constituents of polymers
- Plastics: Thermosets and Thermoplasts
- Preparation, properties and uses of Polyethylene, Bakelite, Terylene and Nylon
- Elastomers – natural rubber, vulcanization, Synthetic Rubbers viz. Buna-S, Buna-N, Butyl and neoprene rubbers

*B.TECH. (FOOD TECHNOLOGY) (SEMESTER-I)*  
(Credit Based Continuous Evaluation Grading System)

**Lubricants**

- Introduction, classification and uses of lubricants
- Types of lubrication.
- Viscosity and viscosity index, flash and fire point, cloud and pour point, steam emulsification number, precipitation number and neutralization number

**Recommended Books:**

1. Engineering Chemistry by P.C. Jain and Monica Jain. Dhapat Rai Publishers, New Delhi.
2. Chemical Process Industries by R. Norris Shrive. McGraw Hill Ltd, New Delhi.

**ENL-101: COMMUNICATIVE ENGLISH**

**Time: 3 Hrs.**  
**(L=2,T=0,U=0)**

**Credits: 02**

**Objective:** To introduce students to the skills and strategies of reading and writing by identifying organizational patterns, spotting classification systems and understanding associations between ideas. This course will prepare students to read a variety of texts and also to communicate more effectively through writing. The course will also pay special attention to vocabulary building.

**Prescribed Text books:**

1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

**Course Contents:**

**1. Reading and Comprehension Skills:**

Students will be required to read and comprehend the essays in Unit 1 and 2 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

**2. Developing Vocabulary and using it in the Right Context:**

The students will be required to master “Word List” and “Correct Usage of Commonly Used Words and Phrases” from the Chapter “Vocabulary” in the book *The Written Word*.

**3. Writing Skills**

Students will be required to learn “Report Writing” and “Letter Writing” as in the book *The Written Word*.

Students will be required to write long essays based on the prescribed text book *Making Connections: A Strategic Approach to Academic Reading*.

**Minor 1:**

**Syllabus to be covered:**

1. Unit 1 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. Report Writing from *The Written Word*.



**Suggested Paper Pattern:**

1. Report Writing ( 8 marks)
2. Short answer type questions from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 1 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

**Minor 2:****Syllabus to be covered:**

1. “Word List” from the Chapter “Vocabulary” in the book *The Written Word*.
2. Unit-2 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

**Suggested Paper Pattern:**

1. Word List from the Chapter “Vocabulary” in the book *The Written Word* (8 marks)
2. Short answer type questions from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

**Suggested Paper Pattern for Major Exam:**

1. Letter Writing as prescribed in *The Written Word* /1 out of 2 (10 marks)
2. Short answer type questions from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* (14 marks)
3. “Word List” and “Correct Usage of Commonly Used Words and Phrases” from the Chapter “Vocabulary” present in the book *The Written Word*. (10 marks)
4. Essay type question from Unit 1,2 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (8 marks)
5. Report Writing from *The Written Word* (8 marks)

**Credits: 2-0-0**

2. pʰ pʷlɪkɪpɪn-ɖaŋ pɪɣ  
(E'qɪn En'qɪn pɪsɪk dɪkʰɪl B'g ival 15 pɪr E-ɖɪ EɪBɛ's kɪv'ak)

**PBL-122: ਮੁੱਢਲੀ ਪੰਜਾਬੀ**  
(In lieu of Punjabi Compulsory)

**Credits: 2-0-0**

**ਪਾਠ-ਕ੍ਰਮ**

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ,  
ਗੁਰਮੁਖੀ ਲਿਪੀ  
ਗੁਰਮੁਖੀ ਲਿਪੀ : ਬਣਤਰ ਅਤੇ ਤਰਤੀਬ
2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ  
ਸੂਰ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ  
ਵਿਅੰਜਨ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ
3. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ  
ਸਾਧਾਰਨ ਸ਼ਬਦ  
ਇਕ ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ

**ਯੂਨਿਟ ਅਤੇ ਥੀਮ**

1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ : ਨਾਮਕਰਣ ਅਤੇ ਸੰਖੇਪ ਜਾਣ ਪਛਾਣ, ਗੁਰਮੁਖੀ ਲਿਪੀ : ਨਾਮਕਰਣ, ਗੁਰਮੁਖੀ ਵਰਣਮਾਲਾ; ਪੈਂਤੀ ਅੱਖਰੀ, ਅੱਖਰ ਕ੍ਰਮ, ਸੂਰ ਵਾਹਕ (ਓ ਅ ਏ), ਲਗਾਂ ਮਾਤਰਾਂ, ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣ, ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣ, ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ।
2. ਗੁਰਮੁਖੀ ਆਰਥੋਗ੍ਰਾਫੀ ਅਤੇ ਉਚਾਰਨ; ਸੂਰਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ (ਲਘੂ-ਦੀਰਘ ਸੂਰ); ਸੂਰ ਅਤੇ ਲਗਾਂ ਮਾਤਰਾਂ; ਵਿਅੰਜਨਾਂ ਦੀ ਬਣਤਰ ਅਤੇ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਪੈਣ ਵਾਲੇ ਵਰਣਾਂ (ਹ, ਰ, ਵ) ਦਾ ਉਚਾਰਨ ; ਲ ਅਤੇ ਲ਼ ਦਾ ਉਚਾਰਨ; ਭ, ਧ, ਢ, ਝ, ਞ ਦਾ ਉਚਾਰਨ; ਪੈਰ ਵਿਚ ਬਿੰਦੀ ਵਾਲੇ ਵਰਣਾਂ ਦਾ ਉਚਾਰਨ।
3. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸਾਧਾਰਨ ਸ਼ਬਦ; ਇਕੱਲਾ ਸੂਰ (ਜਿਵੇਂ ਆ); ਸੂਰ ਅਤੇ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਆਰ); ਵਿਅੰਜਨ ਅਤੇ ਸੂਰ (ਜਿਵੇਂ ਪਾ); ਵਿਅੰਜਨ ਸੂਰ ਵਿਅੰਜਨ (ਜਿਵੇਂ ਪਾਰ); ਕੋਸ਼ਗਤ ਸ਼ਬਦ (ਜਿਵੇਂ ਘਰ, ਪੀ); ਵਿਆਕਰਣਕ ਸ਼ਬਦ (ਜਿਵੇਂ ਨੂੰ, ਨੇ); ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ-1; ਲਿੰਗ-ਪੁਲਿੰਗ, ਇਕ ਵਚਨ-ਬਹੁ ਵਚਨ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ-1: ਖਾਣ-ਪੀਣ, ਸਾਕਾਦਾਰੀ, ਰੁੱਤਾਂ, ਮਹੀਨਿਆਂ, ਗਿਣਤੀ, ਮੌਸਮ ਆਦਿ ਨਾਲ ਸੰਬੰਧਿਤ।

**FTP-121: MANUFACTURING PROCESSES**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

***1. Machine Shop***

Machine shop practice on Lathe, Milling machine and sharper simple jobs.

***2. Carpentry Shop***

Simple, jobs on sawing, ripping, planing and chiselling, wood turning, practice in carpentry shop.

***3. Foundry Shop***

Sand mixing and mold making of simple jobs practice in foundry shop.

***4. Fitting Shop***

Simple jobs on fitting, sawing, tapping and dieing practice in fitting shop.

***5. Sheet Metal Shop***

Cutting and joining of sheet metal jobs, simple cylindrical jobs, Practice in sheet metal shop.

***6. Smithy Shop***

Simple jobs practice in smithy shop.

***7. Welding Shop***

Fillet joint welding and corner joint welding – practice in welding shop.

***8. Electrical shop***

Single switch wiring for house hold and winding of coils practice in electrical shop.

**FTP-122: PRINCIPLES OF FOOD PRESERVATION**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Demonstration of different machinery used in food processing.
2. Canning operations.
3. Cut out analysis of canned product.
4. Preparation and analysis of syrups and brines.
5. Blanching of fruits and vegetables.
6. Chemical preservation of processed foods.
7. Evaluation of ingredients used in food processing.
8. Dehydration of food.
9. Refrigeration/cold storage of food.
10. Mold inhibitor in bakery products.
11. Fermented products: dairy, cereals, fruits and vegetables, meat.
12. Freezing of foods.
13. Intermediate moisture foods.

**CYP-196: PRACTICAL CHEMISTRY**

**Credits: 0-0-2**

1. Find the strength of  $\text{KMnO}_4$  solution.
2. Determine number of water molecules in Mohr salt by titration method.
3. Determine percentage of sodium carbonate in given sample of washing soda.
4. Determine percentage of sodium carbonate and sodium hydroxide in given sample of caustic soda.
5. Determination of total Hardness of Water.
6. Determine the percentage of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  in the given sample of water.
7. To determine the molecular weight of a compound by Rast's micro method.
8. Determination of coefficient of viscosity of a given liquid by viscometer.
9. To determine the unknown composition of a given mixture of two liquids by viscosity method.
10. To find the mol. wt. of high polymer by using viscosity measurements.
11. Determination of surface tension of a given liquid by drop number method by stalagmometer.
12. To determine the critical micelle concentration of a soap (sodium laurate) by surface tension measurements.
13. To determine the distribution coefficient of  $\text{I}_2$  between  $\text{CCl}_4$  and water.
14. To determine refractive index of a liquid by Abbe's refractometer and hence the specific and molar refraction.
15. Determination of Chlorine in bleaching powder.

**Recommended Books:**

1. Findlay's Practical Physical Chemistry.
2. Advanced Practical Physical Chemistry by J.B. Jadav.
3. Quantitative Organic Analysis by Vogel.

**FTL-152: THERMAL SCIENCE****Credits: 3-1-0****Note: Students can use the Non-Programmable scientific calculator.****UNIT-I**

**1. Basic Concepts:** Thermodynamic system, boundary and surroundings; open, closed and isolated systems. State, property, process and cycles. Energy and its forms. Energy transfer across system boundaries; heat and work. Point and path functions. Pure substances and their phases. Zeroth Law, concept of thermal equilibrium and principle of thermometry.

**2. Open and Closed System Processes:** Ideal gas and characteristic gas equation. Analysis of non- flow and flow processes for an ideal gas under constant volume (Isochoric), constant pressure (isobaric), constant temperature (isothermal), adiabatic and polytropic conditions. Property changes, work done and heat exchange during these processes. Free expansion and throttling processes.

**UNIT-II**

**3. First Law of Thermodynamics:** Introduction to first law of thermodynamics, heat transfer, work. Internal energy, enthalpy and specific heat of ideal gases, solids and liquids. First law analysis of steady flow, applications of steady flow energy equation to engineering devices. Thermodynamic aspects of biological systems.

**4. Second Law of Thermodynamics:** Limitations of first law. Kelvin Plank and Clausius statements of second law and their equivalence; their applications to a refrigerator, heat pump and heat engines.  
Reversible and irreversible processes, conditions for reversibility.

**UNIT-III**

**5. Gas Power Cycles:** piston cylinder arrangement, philosophy of Otto and Diesel combustion cycle; their compression ratio, mean effective pressure, power output and efficiency; comparison between the two cycles.

**6. Internal Combustion Engines:** Classification and application, constructional and working details of two stroke and four stroke cycle engines.

**Recommended Books:**

1. Basic Engineering Thermodynamics by MW Zemansky and HC Vaness. McGraw Hill Book Co., Tokyo International Student Edition.
2. Applied Thermodynamics for Engineers and Technologists by TD Estop and A McConkey; Longman Scientific and Technical.
3. Heat Engineering by VP Vasandani and BS Kumar; Metropolitan Book Company Pvt. Ltd., 1, Netaji Subhash Marg, New Delhi.
4. Thermodynamics by JP Helman; McGraw Hill.
5. Engineering Thermodynamics by DB Spalding and DH Cole; ELBS and Edward Arnold Pub. Ltd., (Low Priced Ed.).
6. Introduction to Thermodynamics and Heat Transfer by Y.A. Cengel. McGraw Hill Companies, Inc.



**FTL-153: FOOD CHEMISTRY****Credits: 3-0-0**

**Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

**Food Constituents:** Proximate composition of foods, water in foods, Carbohydrate. Introduction, Definition nomenclature, classification. General properties of sugar (physical and chemical) identification of common mono saccharides, disaccharides and polysaccharides, determination of the amount of reducing and non – reducing sugars. Chemistry of starch, glycogen, cellulose, gums and mucilage, crude fibre. Physiological functions of characteristics.

**Natural Pigments and Flavouring Agents:** Chlorophyll, carotenoids, anthocyanins, anthoxanthins, flavonoids, tannins. Natural flavour constituents.

**Vitamins:** Occurrence, chemistry, loss during storage, transport and processing of foods of provitamins. A and D, vitamin A, D, E, K, C, B1, B2, Niacin, pyridoxin, cyanocobalamin, folic acids. P – aminobenzoic acid, biotin, choline.

**UNIT-II**

**Protein:** Physical and Chemical properties of amino acids, chromatographic separation of amino acids. Classification of proteins, amino acid sequence in proteins, pleated sheet and helix structure of protein tertiary structure and conformation of proteins. Physical and chemical properties of proteins, molecular weight of proteins and ultracentrifuge preparation and purification of proteins, protein denaturation, food proteins and their characteristics.

**UNIT-III**

**Lipids:** Classification of lipids, fatty acid, soap and detergent, essential fatty acids, fats and oils saponification number acid numbers iodine value, acetyl value, Reichart – Meissl number, Oxidative and hydrolytic rancidity, reversion, waxes phosphoglycerides, sphingolipids, non – saponifiable lipids, cholesterol, prostaglandins, lipid bilayers, monolayers and micelles, structure of cell membrane.

**Recommended Books:**

1. Food Chemistry – Meyer.
2. Food Chemistry – Fennema.
3. Physiological Chemistry – Lehniger.
4. Fundamentals of Food Chemistry Laboratory- J. Kaur, Houghton Mifflin Company, New York (2006)

**FTL-155: Applied Mathematics****Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

**Differential Calculus:** Partial derivatives, Euler's theorem for homogeneous functions, total derivative, change of variables, Lagrange's methods of undetermined multipliers. Exact differential equations, integrating factors, Linear differential equations, Cauchy's form, Legendre linear equations, simultaneous linear equations with constant coefficients, Total differential equations.

**UNIT-II**

**Statistical Methods:** A general introduction about the role of statistics in science and technology, Classification and tabulation of frequency distribution, Diagrammatic and graphical representation of frequency distribution data, Measures of central tendency, dispersion, skewness and kurtosis. Correlation and regression analysis for bivariate data, partial and multiple correlations (for three variables only).

**UNIT-III**

**Probability and Statistical Inference:** An introduction to probability and random variables, Binomial, Poisson and Normal probability distributions, their definitions and important applications in the industry. Random sample, Tests of hypothesis and level of significance. Chi-square, t and Z tests: their applications in industry.

**Recommended Books**

1. N.P. Bali: A text book of Engineering Mathematics.
2. B.S. Grewal: Higher Engineering Mathematics.
3. Fundamentals of Statistics by S.C. Gupta, Himalaya Publishing House.

**ENL-151: COMMUNICATIVE ENGLISH**

**Time: 3 Hrs.**

**Credits: 02 (L=2,T=0,U=0)**

**Objectives:** To equip students with the skill of reading and writing dexterously. By the end of the course the students will be skilled in the art of expressing their ideas in short and long compositions, noting information effectively and summarizing and abstracting more efficiently.

**Prescribed Text books:**

1. *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

**Course Contents:**

**1. Reading and Comprehension Skills:**

Students will be required to read and comprehend the essays in Unit 3 and 4 of the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition. They will be required to answer the questions given after each essay.

**2. Writing Skills**

Students will be required to learn Paragraph and Essay Writing and Note Making, Summarizing and Abstracting as in the book *The Written Word* by Vandana R. Singh, Oxford University Press, New Delhi.

**Minor 1:**

**Syllabus to be covered:**

1. Unit 3 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.
2. ABC of Good notes, Sub dividing your Notes and Summarizing and abstracting included in the Chapter “Note Making, Summarizing and Abstracting” from *The Written Word*.

**Suggested Paper Pattern:**

1. Theoretical questions based on ABC of Good notes, Sub dividing your Notes and Summarizing and abstracting included in the Chapter “Note Making, Summarizing and Abstracting” *The Written Word* (8 marks).
2. Short answer type questions from Unit 3 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks).
3. Essay type question from Unit 3 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks).

**B.TECH. (FOOD TECHNOLOGY) SEMESTER-II**  
(Credit Based Continuous Evaluation Grading System)

**Minor 2:**

**Syllabus to be covered:**

1. Abbreviations and Symbols and Note making in practice from the chapter “Note-Making, Summarizing and Abstracting in the book *The Written Word*
2. Unit-4 from the book *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

**Suggested Paper Pattern:**

1. A practical question on Note making in practice “Note-Making, Summarizing and Abstracting” from the chapter the book *The Written Word* (8 marks)
2. Short answer type questions from Unit 4 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)
3. Essay type question from Unit 2 of *Making Connections: A Strategic Approach to Academic Reading* (6 marks)

**Suggested Paper Pattern for Major Exam:**

1. Practical Question on Paragraph and Essay Writing as prescribed in *The Written Word* /1 out of 2 (10 marks)
2. Short answer type questions from Unit 3,4 of *Making Connections: A Strategic Approach to Academic Reading* (16 marks)
3. Essay type question from Unit 3,4 of *Making Connections: A Strategic Approach to Academic Reading* 1 out of 2 (10 marks)
4. Practical Question on Note Making from *The Written Word* (8 marks)
5. Theoretical Question(s) based on the two chapters from the book *The Written Word* (6 marks)

**PBL 131 Punjabi (Compulsory) ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ**  
ਪ੍ਰੋ-ਟੈਕਸਟ ਬੁਕ ਨਹੀਂ ਹੈ

**Credits: 2-0-0**

- (I) 1. E'qm En'qm (s'p. virE'm is'G s'DUEq'f. si'h'lrblr is'G, gr'l'n'k dy whlvristl, E'lm'qsr) iv'e'lhjT il Kykvl :
- (a) B'el vlr is'G  
(E) p'l p'lr'n is'G  
(e) p'l m'h'n is'G  
(kivq'-s'r, ivS'-vsq'v k'iv-kl`, kvl)
2. p'j'bl Sbd bxqr: D'q'v'm' , vD'qr (Eg'qr, ipC'qr, ival'p'p'q Eq'yr'p-q'rl), sm's |
- (II) 1. E'qm En'qm (s'p. virE'm is'G s'DUEq'f. si'h'lrblr is'G, gr'l'n'k dy whlvristl, E'lm'qsr) iv'e'lhjT il Kykvl :
- (a) E'lm'q' p'l'qm  
(E) f. hrB'j'n is'G  
(e) iSv k'm'r bt'l vl  
(kivq'-s'r, ivS'-vsq'v k'iv-kl`, kvl)
2. p'r'h'rcn' : kl`s iv'e 10 iviSE- (siBE'c'rk, D'rimk Eq'yr'j n'lqk) q'yp'r'h'rcn' dy EiBE's kr'v'ax'v|
- (III) 1. E'qm En'qm (s'p. virE'm is'G s'DUEq'f. si'h'lrblr is'G, gr'l'n'k dy whlvristl, E'lm'qsr) iv'e'lhjT il Kykvl :
- (a) f. j sv'v'q is'G n'kl  
(E) f. j gq'r  
(e) f. sr'j lq p'qr  
(s) p'S  
(kivq'-s'r, ivS'-vsq'v k'iv-kl`, kvl)
2. m'h'vryq'E'K'x (E'K'x q'ym'h'vr' k'G iv'e) 200 m'h'virE- Eq'j100 E'K'x- n'l'v'k- iv'e vrqx dy EiBE's kr'v'ax'v (kl`s iv'e q'vGr l el)|

**PBL-132: ਮੁੱਢਲੀ ਪੰਜਾਬੀ**  
(In lieu of Punjabi Compulsory)

**Credits: 2-0-0**

**ਪਾਠ-ਕ੍ਰਮ**

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ  
ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਸ਼ਬਦ  
ਬਹੁ-ਉਚਾਰਖੰਡੀ ਸ਼ਬਦ
2. ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ  
ਸਾਧਾਰਨ-ਵਾਕ : ਕਿਸਮਾਂ  
ਸੰਯੁਕਤ-ਵਾਕ : ਕਿਸਮਾਂ  
ਮਿਸ਼ਰਤ-ਵਾਕ : ਕਿਸਮਾਂ
3. ਪ੍ਰਕਾਰਜੀ ਪੰਜਾਬੀ  
ਚਿੱਠੀ ਪੱਤਰ  
ਪੈਰਾ ਰਚਨਾ  
ਸੰਖੇਪ ਰਚਨਾ  
ਅਖਾਣ ਅਤੇ ਮੁਹਾਵਰੇ

**ਯੂਨਿਟ ਅਤੇ ਥੀਮ**

1. ਪੰਜਾਬੀ ਸ਼ਬਦ-ਬਣਤਰ : ਸੰਯੁਕਤ ਸ਼ਬਦ; ਸਮਾਸੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਲੋਕ ਸਭਾ); ਦੋਜਾਤੀ ਸ਼ਬਦ (ਜਿਵੇਂ ਕਾਲਾ ਸਿਆਹ); ਦੋਹਰੇ ਸ਼ਬਦ/ਦੁਹਰਰੁਕਤੀ (ਜਿਵੇਂ ਧੂੜ ਧਾੜ੍ਹ/ਭਰ ਭਰ), ਮਿਸ਼ਰਤ ਸ਼ਬਦਾਂ ਦੀ ਬਣਤਰ/ਸਿਰਜਨਾ; ਅਗੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਉਪ ਭਾਸ਼ਾ), ਪਿਛੇਤਰਾਂ ਰਾਹੀਂ (ਜਿਵੇਂ ਰੰਗਲਾ), ਪੰਜਾਬੀ ਸ਼ਬਦ ਰਚਨਾ-2: ਪੜਨਾਵੀਂ ਰੂਪ, ਕਿਰਿਆ/ਸਹਾਇਕ ਕਿਰਿਆ ਦੇ ਰੂਪ; ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ-2: ਮਾਰਕੀਟ/ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਿਤ।
2. ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ : ਕਰਤਾ ਕਰਮ ਕਿਰਿਆ; ਸਾਧਾਰਨ ਵਾਕ, ਬਿਆਨੀਆ, ਪ੍ਰਸ਼ਨਵਾਚਕ, ਆਗਿਆਵਾਚਕ, ਸੰਯੁਕਤ ਅਤੇ ਮਿਸ਼ਰਤ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ; ਸੁਤੰਤਰ ਅਤੇ ਅਧੀਨ ਉਪਵਾਕ; ਸਮਾਨ (ਤੇ/ਅਤੇ) ਅਤੇ ਅਧੀਨ (ਜੋ/ਕਿ) ਯੋਜਕਾਂ ਦੀ ਵਰਤੋਂ; ਪੰਜਾਬੀ ਵਾਕਾਂ ਦੀ ਵਰਤੋਂ : ਵਿਭਿੰਨ ਸਮਾਜਕ/ਸਭਿਆਚਾਰਕ ਪ੍ਰਸਥਿਤੀਆਂ ਦੇ ਅੰਤਰਗਤ; ਘਰ ਵਿਚ, ਬਾਜ਼ਾਰ ਵਿਚ, ਮੇਲੇ ਵਿਚ, ਸ਼ੋਪਿੰਗ ਮਾਲ/ਸਿਨੇਮੇ ਵਿਚ, ਵਿਆਹ ਵਿਚ, ਧਾਰਮਿਕ ਸਥਾਨਾਂ ਵਿਚ, ਦੋਸਤਾਂ ਨਾਲ ਆਦਿ।
3. ਇਸ ਯੂਨਿਟ ਵਿਚ ਚਿੱਠੀ ਪੱਤਰ (ਨਿੱਜੀ/ਦਫ਼ਤਰੀ/ਵਪਾਰਕ), ਪੈਰਾ ਰਚਨਾ, ਸੰਖੇਪ ਰਚਨਾ ਅਤੇ ਅਖਾਣ ਮੁਹਾਵਰਿਆਂ ਦੀ ਵਰਤੋਂ ਰਾਹੀਂ ਵਿਦਿਆਰਥੀ ਦੀ ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਨੂੰ ਪਰਖਿਆ ਜਾਵੇਗਾ।

**FTP-172: FOOD CHEMISTRY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Preparation of sample for analysis.
2. Determination of acidity/ pH in food.
3. Preparation of standard solutions.
4. Determination of moisture, ash, lipids, protein.
5. Crude fiber, reducing and non – reducing sugar.
6. Estimation of minerals such Ca, Mg, K, Fe, Cu, etc.
7. Estimation of ascorbic acid.

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**FTP-173: ENGINEERING GRAPHICS AND DRAFTING**

**Credits: 0-0-3**

**Note: Students can use the Non-Programmable scientific calculator.**

Drawing Practice based on problems on topic covered in Engineering Graphics.



**FTL–201: BASIC FOOD ENGINEERING**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT I**

1. **Dimensions and engineering units:** Definition of terms, base, derived and supplementary units, different systems of measurement, dimensional equations, conversion of units using dimensional equations.
2. **Properties of fluids and solids:** State of a system, definition of extensive and intensive properties, density, concentration, moisture content, pressure, temperature, viscosity, enthalpy, equation of state and perfect gas law, phase diagram of water.

**UNIT II**

3. **Material balances:** Principles of material and component balance, steady state and unsteady state processes. Material balance problems in drying, evaporation, dilution, mixing, separation and combined processes with and without recycle.

**UNIT III**

4. **Energy balance:** Principles of energy conversion and conservation, energy balance problems with and without material balance. Typical industrial problems of combined material and energy balances.
5. **Preservation processes:** Microbial survivor curves, thermal death time, spoilage probability, general method for process calculations: applications to pasteurization, sterilization, aseptic processing and packaging.

**Recommended Books:**

1. Fundamentals of Food Engineering by R.C. Verma and S.K. Jain, Himanshu Publications, Udaipur, 2002.
2. Fundamentals of Food Process Engineering by R.T. Toledo, CBS Publishers and Distributors, New Delhi, 2000.
3. Introduction to Food Engineering by R.P. Singh and D.R. Heldman, Academic Press, London, 2004.
4. Food Processing Technology Principles and Practices by P.J. Fellows, Woodhead Publishing Limited, Cambridge, 2005.

**FTL–202: BASIC MICROBIOLOGY**

**Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Microbiology and its scope.

Microscopy, classification.

Morphology and physiology of bacteria, yeast, molds and algae growth.

Nutrition and reproduction, isolation and identification of micro organisms.

Pure cultures and their characteristics.

Maintenance of cultures, culture techniques, enumeration techniques.

**UNIT-II**

Physical and chemical methods of control of micro organisms.

Virus, common pathogenic organisms, immune response.

Antigen - antibody interaction and antibodies.

Microbial ecology.

Microbial interactions.

**UNIT-III**

Incidences of micro-organisms in soil, water, air, food and sewage.

Food spoilage organisms.

Food borne infections and poisoning organisms, sanitation and Hygiene.

**Recommended Books:**

1. Bacteriology - A.J. Salley, 2007.
2. Microbiology - Palczer, Chan and Creig.
3. Modern Food Microbiology – Jay, 2000.
4. Basic Food Microbiology – Banwart, 1981.
5. Food Microbiology - Frazier and Westhoff, 2008.

**FTL-203: FOOD HYGIENE AND SANITATION**

**Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

General principles of food hygiene. Personal hygiene. Food handling habits, water sources and impurities in water supply and treatment. Sanitation facilities and procedures in food plant operation.

**UNIT-II**

Quality standards for potable water supply. Microbial standards for foods. Sanitation in food service institution.

**UNIT-III**

Method of cleaning and disinfection. Detergents and Sanitizer. Recommended International code of hygiene for food products.

**Recommended Books:**

1. Guide to improving Food Hygiene - Ed Gaston and Tiffney.
2. Practical Food Microbiology and Technology (2nd edition) – J. Mountney and W.A. Gould, 1988.
3. Food Poisoning and Food Hygiene - Betty C. Hobbs (3rd Edition).

**FTL-206: SUGAR PROCESSING AND REFINING****Credits: 3-0-0****UNIT-I**

1. Juice extraction, maceration and imbibitions, mill sanitation. Color and coloured non-sugars, removal of color by precipitates and adsorbents. Composition of cane and beet juice- their differences, principles of cane juice clarification, different processes of cane juice clarification.
2. Ion exchange process, role of Ion exchange resins, Application of Ion exchange, different techniques of Ion exchange, regeneration of resins, plant requirement-operation and economics.
3. Settling tank, and different types of clarifier. Plate and frame type filter presses, continuous filter. Juice heaters, heat exchangers, use of vapours and steam economy.
4. Evaporation-study of different types of evaporators multiple effect, vapour cell/preevaporators-Vapour bleeding systems, condenser barometric, multijet.
5. Syrup: Syrup brix and pH and their role in pan boiling, treatment/clarification of syrup.

**UNIT-II**

6. Classien's theory of pan boiling. Concept or Massequite boiling, different types of massequite boiling i.e., 2M/C boiling, 3M/C boiling, 4 M/C boiling. Ideas of purities of different intermediate massequite and molasses. False grain and conglomerates formation and their removal.
7. Concept of crystallization of sugar in crystallizer, factors affecting the rate of crystallization, Air cooled and water cooled crystallizers.
8. Theory of centrifugals, different types of drive, gravity factor numerical based upon G.F. Batch type and continuous type centrifugals.
9. Sugar Driers: Types of sugar driers, Grass hopper type drier, its working, drying and cooling of sugar, Grading of sugar.
10. Storage of Sugar, Quality of Sugar, Storage of Molasses, Precaution to be taken during storage

**UNIT-III**

11. Sugar Beet: Beet Storage: Beet silos or piles, equipment used, type of pile covering, factors affecting piling losses, reclaiming, fluming operation.
12. Primary Operation and Equipment. Diffusion: Definition and explanation, theory of diffusion, factor affecting diffusion.
13. Refining Process and Operations: Affination, phosphatation for turbidity and color removal, carbonation for turbidity and color removal, ion-exchange resin processes for color and ash removal.

*B.TECH. (FOOD TECHNOLOGY) SEMESTER-III*  
(Credit Based Continuous Evaluation Grading System)

**Recommended Books:**

1. Manufacture and refining of raw cane sugar by Baikow, V.E., (1982- IInd Edition), Elsevier Publishing Co.
2. Handbook of Cane Sugar Technology by Mathur, R.B.L, (1986- IInd Edition), Oxford and IBH Publishing Co.
3. Principles of Sugar Technology Vol. I by Pieter Honig, (1953-Ist Edition), Elsevier Publishing Co.
4. Principles of Sugar Technology Vol. II by Pieter Honig, (1959-Ist Edition), Elsevier Publishing Co.
5. Handbook of Cane Sugar Engineering by E. Hugot. (1986-IIIrd Edition), Elsevier Science Publishers.

**ESL 220 Environmental Studies (Compulsory Paper)**

**Credit 3-0-0**

- 1. The Multidisciplinary Nature of Environmental Studies:** Definition, scope & its importance, Need for public awareness.
- 2. Natural Resources:** Natural resources and associated problems.
  - a) Forest Resources:** Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
  - b) Water Resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
  - c) Mineral Resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
  - d) Food Resources:** World food problems, change caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problem, salinity, case studies.
  - e) Energy Resources:** Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
  - f) Land Resources:** Land as a resource, land degradation, soil erosion and desertification.
  - g) Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.**
- 3. Ecosystem:**

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:

  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
- 4. Biodiversity and its Conservation:**

**Definition:** Genetic, species and ecosystem diversity, Biogeographical classification of India.

**Value of Biodiversity:** Consumptive use; productive use, social, ethical, aesthetic and option values.

Biodiversity of global, National and local levels, India as mega-diversity nation "Hot-spots of biodiversity.

**Threats to Biodiversity:** Habitat loss, poaching of wild life, man wildlife conflicts

Endangered and endemic species of India.

**Conservation of Biodiversity:** In situ and Ex-situ conservation of biodiversity.
- 5. Environmental Pollution:**

Definition, Causes, effects and control measures of:

  - a) Air Pollution
  - b) Water Pollution
  - c) Soil Pollution
  - d) Marine Pollution

**B.TECH. (FOOD TECHNOLOGY) SEMESTER-III**  
(Credit Based Continuous Evaluation Grading System)

- e) Noise Pollution
- f) Thermal Pollution
- g) Nuclear Hazards

**Solid Waste Management:** Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies Disaster Management: Floods, Earthquake, Cyclone and Landslides

**6. Social Issues and Environment:**

- \* From unsustainable to sustainable development
- \* Urban problems related to energy
- \* Water conservation, rain water harvesting, watershed management
- \* Resettlement and rehabilitation of people; its problems and concerns. Case studies
- \* Environmental ethics: Issues and possible solutions.
- \* Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- \* Wasteland reclamation
- \* Consumerism and waste products
- \* Environmental Protection Act
- \* Air (prevention and Control of Pollution) Act
- \* Water (prevention and Control of Pollution) Act
- \* Wildlife Protection Act
- \* Forest Conservation Act
- \* Issues involved in enforcement of environmental legislation
- \* Public awareness

**7. Human Population and the Environment**

- \* Population growth, variation among nations
- \* Population explosion-Family welfare programme
- \* Environment and human health
- \* Human rights
- \* Value education
- \* HIV / AIDS
- \* Women and child welfare
- \* Role of information technology in environment: and human health
- \* Case studies
- \* **Road Safety Rules & Regulations:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs
- \* **Accident & First Aid:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance

**8. National Service Scheme**

- **Introduction and Basic Concepts of NSS:** History, philosophy, aims & objectives of NSS: Emblem, flag, motto, song, badge etc.; Organization structure, roles and responsibilities of various NSS functionaries.
- **Health, Hygiene & Sanitation:** Definition, needs and scope of health education; Food and Nutrition; Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan); National Health Programme; Reproductive health.

**B.TECH. (FOOD TECHNOLOGY) SEMESTER-III**  
(Credit Based Continuous Evaluation Grading System)

- **Civil/Self Defense:** Civil defense services, aims and objectives of civil defense; Needs for self defense training.

**9. Field Work:** Visit to a local area to document environmental assets–river / forest / grassland / hill / mountain. Visit to a local polluted site–Urban / Rural / Industrial / Agricultural. Study of common plants, insects, birds. Study of simple ecosystems–pond, river, hill slopes, etc. (Field work equal to 5 lecture hours)

**References:**

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Bharucha, E. 2004. The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.
4. Brunner, R. C. 1989. Hazardous Waste Incineration, McGraw Hill Inc. New York.
5. Clark, R. S. 2000. Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W. P., Cooper, T. H., Gorhani, E. & Hepworth, M. T. 2001. Environmental Encyclopedia, Jaico Publications House, Mumbai.
7. De, A. K. 1989. Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment, New Delhi.
9. Hawkins, R. E. 2000. Encyclopedia of Indian Natural History, Bombay Natural History Society.
10. Heywood, V. H & Waston, R. T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
11. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
12. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
13. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
14. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
15. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
16. Rajagopalan, R. 2005. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
17. Sharma, B. K. 2001. Environmental Chemistry. Geol Publishing House, Meerut.
18. Sharma, J. P. 2004. Comprehensive Environmental Studies, Laxmi Publications (P) Ltd, New Delhi.
19. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
20. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.
21. Survey of the Environment. 2005. The Hindu.
22. Tiwari, S. C. 2003. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehra Dun.
23. Townsend, C., Harper, J. and Michael, B. 2001. Essentials of Ecology, Blackwell Science.
24. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar



**ECL-210: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

1. **Electric Current and Ohm's Law**  
Ohm's Law, Resistance in Series, Resistance in Parallel, Division of current in Parallel circuits, Equivalent Resistance, Numericals.
2. **Network Theorems:** Kirchhof's laws, Thevenin Theorem, Work, Power and Energy effect of electric current, Joule's law of Electric heating Numericals.
3. **Electromagnetic Induction and A.C. Fundamentals:**  
Faraday's law of Electromagnetic Induction, Generation of Alternating voltage, current, simple wave form, cycle Time period, frequency, Amplitude, phase, phase difference.
4. **Transformer:** Working principle of a Transformer construction, Elementary Theory of an ideal Transformer E.M.F. Equation of a Transformer Voltage Transformation Ratio Efficiency of a Transformer.

**UNIT-II**

5. **Induction motor:** Classification of A.C. Motors General Principle, construction, Relation between Torque and Slip, control of A.C. motors.
6. **D.C. Generators and D.C. Motors:** Generator Principle, Construction and working of Generator, Motor Principle, Comparison of Generator and Motor action, comparison of shunt, series Motors, losses and Efficiency Powerstages, Speed control of D.C. Motors.

**UNIT-III**

7. **Electronic Devices:** Semiconductors, Bipolar Junction Transistor., transistor circuit configuration transistor characteristics, Field Effect Transistor.
8. Amplifiers, Classification, Concept of feedback amplifiers.
9. Special Diodes, Zener Diode, Voltage, Regulation.
10. Introduction to DSO (Digital Storage Oscilloscope) and CRO (Cathode Ray Oscilloscope), Electronic versus electrical Instruments.

**Recommended Books:**

1. Principle of Electrical Engg. by Vincent Del Tora.
2. Basic Electronics by G.K. Mittal, 2003.
3. Electronic Principles by A.P. Malvino, 1999.

**FTP-221: BASIC MICROBIOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Introduction to Microscopic techniques in the identification of Microorganisms
2. Specific Staining techniques.
3. Isolation of pure cultures of bacteria, yeasts, and moulds.
4. Identification on the basis of Morphology and Physiology.
5. Preparation of nutrient broth.
6. Preparation of media with nutrient agar, PDA and special media.
7. Measurement of efficacy of anti Microbial agents.

**FTP-224: SUGAR PROCESSING AND REFINING**

**Credits: 0-0-2**

1. Determination of total soluble solids by:
  - a) Refractometer.
  - b) Brix Spindle
  - c) Drying Method.
2. Determination of Pol and calculation of purities juices, syrup, massecuites and other boiling house products.
3. Determination of ash (%) in juices, syrup, massecuites, molasses etc.
  - a) Carbonated Ash.
  - b) Sulphated Ash.
4. Determination of sucrose and gravity purity of juice, syrup, massecuite and other boiling house products by double polarization using Jackson and Gill's method
5. Determination of sucrose and gravity purity of molasses and boiling house products by Fehling's solution method
6. Determination of reducing sugar in Juices, syrups, massecuites, molasses, etc. by Lane and Eynon method.
7. Determination of phosphate content in juice by Ammonium Molybdate method
8. Determination of SO<sub>2</sub> content in juices and syrup.
9. Analysis of lime for available CaO by Phenol Method.
10. Analysis of lime for available CaO by Sucrose Method.
11. Analysis of Commercial Phosphoric acid.
12. Analysis of Blankit (Sodium Hydrosulphite)
13. Visit to the sugar complex.

**Recommended Books:**

1. System of Technology Control for Cane Sugar Factories in India, 1st edition, N.C.Varma.
2. Sugar Analysis by Zerban and Brown IIIrd Edition published by John Wiley and Sons.
3. Handbook of Cane Sugar Technology, IIInd Edition, R.B.L. Mathur.

**FTL-252: CEREALS AND LEGUMES TECHNOLOGY**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

**Rice:** Production, composition, structure and characteristics of varieties, classification and properties, milling, criteria of rice quality and parboiling of paddy, processed foods from rice, rice milling, Machinery and modern rice mill, stabilization of rice bran, by products of rice milling and their uses specifically rice bran oil.

**UNIT-II**

**Wheat:** Production, composition, structure and characteristics of varieties, classification and properties, criteria of grain and flour quality, wheat conditioning and milling, air classification of flour, Flour and its treatment, rheology and chemistry of dough, physical dough testing instruments. Technology of baking bread, biscuit, cookies, cakes, bakery ingredients and their functions. Durum wheat and pasta products like macaroni, noodles and sphagatti. Processing of wheat flakes.

**UNIT-III**

**Corn:** Production, corn type, composition, structure and characteristics of varieties, dry and wet milling of corn, composition and properties of corn starch, corn based ready- to-eat breakfast cereals, alkaline cooked products, tortillas, nixtamalized corn flours, snacks from corn, tortilla chips, extruded snacks, Corn oil – composition, processing and utilization, corn starch modification and uses, corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose and maltodextrin.

**Barley:** Production, structure, composition, milling, malt production, and malting chemistry and technology.

**Legumes:** Production of legumes, minor and major constituents, antinutritional factors production of protein isolates, protein concentrates, legume products.

**Recommended Books:**

1. Technology of Cereals. by N.L. Kent, 1994
2. Wheat Chemistry and Technology- Pomerenz.
3. Corn chemistry and Technology by Tanley A Watson and Paul E. Ramstad.
4. Legumes: Chemistry, Technology and Human Nutrition by Ruth H. Matthews, 1989.
5. Pulse Chemistry and Technology by B. Tiwari and N. Singh (RSC).

**FTL-253: FRUITS AND VEGETABLES TECHNOLOGY**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Prepackaging of fresh fruits and vegetables. Storage techniques for fresh fruits and vegetables. Processing of fruit juices.

**UNIT-II**

Manufacturing of fruit juices concentrates. Processing of vegetable juice, puree and pastes. Preparation of jam, jellies and marmalades.

**UNIT-III**

Preparation of preserve and candied fruits. Pickling of fruits and vegetables. Preparation of wine. Canning of fruits and vegetables. Drying and dehydration of fruits and vegetables. Freezing and frozen storage of fruits and vegetables. Waste management in fruits and vegetable processing units.

**Recommended Books:**

1. Handbook of Analysis of Fruits and Vegetable Products by S. Rangana, Tata McGraw Hill, New Delhi, 986.
2. Commercial Vegetable Processing – Tressler DK and Woodruff JG, AVI Publishing Co., West port, CT 2004.
3. Commercial Fruit Processing – Woodroof J.G. , Luh B.S. AVI Publishing Co, West Port, CT 2004.

**FTL-254: INDUSTRIAL MICROBIOLOGY**

**Credits : 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Economic activities of microorganisms. Propagation of food, food and baker yeasts. Technology of production of alcohol, glycerol and beer. Mechanism of alcohol and glycerol fermentation. Production of wine and other alcoholic beverages (Whiskey, rum etc.). activities of lactic acid bacteria and industrial, production of lactic acid.

**UNIT-II**

Activities of acetic acid bacteria and production of vinegar, sorbose and dihydroxyacetone. Production of dextrans, amino acid fermentation, metabolic controls in industrial fermentation, saccharifying agents - methods of production and uses. Activities of molds, microbial production of organic acids viz. citric, gluconic, fumeric, itaconic, gibbarellic and kojic acids. Microbial production of vitamins B-2 and B-12. Production, Isolation and uses of microbial enzymes, immobilized enzymes and their applications, production of glucose and fructose and starch by enzymatic methods.

**UNIT-III**

Production of mushroom mycelium by submerged culture process. Production of algal protein and recent advances. Microbiological transformation of steroids. Production and isolation of antibacterial antibiotics like penicillin, streptomycin, tetracycline, chloramphenicol, tetracyclines, semisynthetic penicillins. Antifungal antibiotics.

**Recommended Books:**

1. Industrial Microbiology - Prescott and Dunn., 1983
2. Industrial Microbiology – Casida, 2004.
3. Comprehensive Biotechnology – Moo Young, 1985.

**FTL-258: SUGAR INDUSTRY CO- PRODUCTS****Credits: 3-0-0****UNIT-I**

**General Introduction:** Co-product of cane sugar and Beet sugar industry.

**Bagasse:** Physical and Chemical characters fuel value of bagasse, Ways and means of sparing Bagasse, Handling and Storage of Bagasse, Manufacture of pulp and paper from Bagasse, Manufacture of particle board, fibre board and corrugated board, Use of bagasse as a fuel, production of bagasse production gas, Miscellaneous products from Bagasse; (a) Furfural (b) Cellulose (c) Xylitol (d) Poultry Litter (e) Soil Conditioning (f) Plastics (g) Cattle Feeds (h) Charcoal and Activated Carbon.

**UNIT-II**

**Molasses;** Characteristics of molasses, different types of molasses and their comparison in production and composition, De-sugarization of molasses, Molasses for products of ethyl alcohol, Recovery of CO<sub>2</sub> in distilleries, Molasses for production of: (a) Yeast (b) Monosodium Glutamate (c) Lysine (d) Citric acid (e) Tartaric Acid (f) Oxalic Acid (g) Aconitic Acid (h) Acetone Butanol Ethanol ABS. Use of molasses in live stock feeds, Molasses as fuel, fertilizer in briquetting.

**UNIT-III**

**Filter Mud;** Characteristics, different types and their comparison, Use of filter Mud as a) fertilizer b) fuel c) cattle feed. Filter Mud for manufacture of a) Cane wax b) Biogas c) Cement

**Sugar cane green top:** Composition and utilization.

**Specialty Sugar Products:** Brown or soft sugar, areado soft sugar process, liquid sugar production, microcrystalline sugar.

**Sucrose derivatives:** Brief introduction.

**Recommended Books:**

1. Industrial Utilization of Sugarcane and its Co-Products - P.J. Manohar Rao.
2. Manufacture and refining of raw cane sugar by Baikow, V.E., (1982- IInd Edition), Elsevier Publishing Co.

### **FTL-255: FLUID FLOW AND HEAT TRANSFER**

**Credits: 3-1-0**

**Note: Students can use Non-Programmable scientific calculator.**

#### **UNIT-I**

Nature and classification of fluids. Concept of viscosity and its measurement - capillary tube viscometer, rotational viscometer. Mechanical energy balance, Bernoulli's equation and its application. Friction in pipes and pipe line fittings. Pumps and their classification - positive displacement pumps and centrifugal pumps. Flow measurement devices - Pitot tube, Orifice tube, Venturimeter. Pressure and its measurement - Simple and Differential manometers.

#### **UNIT-II**

Modes of heat transfer-conduction, convection and radiation. Conduction: Fourier's law, applications of steady-state heat transfer i.e. conductive heat transfer in a rectangular slab, tubular pipe, composite rectangular wall (in series), composite cylindrical tube (in series) and sphere. Convection: Free convection and forced convection. Estimation of convective heat transfer coefficient and overall heat transfer coefficient.

#### **UNIT-III**

Critical thickness of insulation. Heat exchangers: Steam injection, Steam infusion, Plate heat exchanger, Scraped surface and Tubular heat exchanger. Design of a tubular heat exchanger by LMTD and NTU-Effectiveness method. Radiation: Stefan-Boltzmann law, Black body, Emissivity, Gray body. Application of radiation in food drying.

#### **Recommended Books:**

1. Introduction to Food Engineering (3<sup>rd</sup> Edition) by R Paul Singh and Dennis R Heldmann; Academic Press, London, UK, 1993
2. Unit Operations of Chemical Engineering (5<sup>th</sup> Edition) by Warren L McCabe, Julian C Smith, Peter Harriott; McGraw-Hill, Inc., New Delhi, 1998
3. Fundamentals of Food Engineering by Radha Charan Verma and Sanjay Kr Jain; Himanshu Publications, Udaipur, 2002
4. Heat Transfer (7<sup>th</sup> Edition) by J P Holman; McGraw-Hill, Inc., New Delhi, 2008.
5. Transport Processes and Unit Operations (3<sup>rd</sup> Edition) by Christie J Geankoplis, Prentice-Hall of India Pvt Ltd, New Delhi, 1999.



**FTL-256: MECHANICAL OPERATIONS****Credits: 3-1-0****Note: Students can use Non-Programmable scientific calculator.****UNIT-I****1. Size Reduction**

General principles, considerations governing equipment selection, size reduction equipment, modes of operation of size reduction plant, calculation of energy requirements for comminution of solids, disintegration of fibrous materials-slicing, dicing, shredding and pulping. Screening terminology, types of screens, effectiveness of screens, screen analysis for particle size determination.

**2. Material Handling**

Theory, types of material handling equipments like belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

**UNIT-II****3. Filtration**

Theory of filtration, filtration equations for constant pressure and constant rate filtration, filtration equipments, filter media and filter aids.

**4. Sedimentation**

Theory, free and hindered settling, sedimentation equipments

**UNIT-III****5. Centrifugal Separation**

Theory, basic equation, rate of separation, liquid separation, gas-solid separation, centrifugation equipments.

**6. Mixing**

Theory, measurement of mixing, rates of mixing, types of mixers – mixers for liquids of low or moderate viscosity, mixers for high viscosity pastes and plastic solids, mixers for dry solids.

**Recommended Books:**

1. Transport Processes and Unit Operations (3<sup>rd</sup> Edition) by Christie J Geankoplis, Prentice- Hall of India Pvt Ltd, New Delhi, 1999.
2. Food Engineering Operations (3<sup>rd</sup> Edition) by J G Brennan, J R Butters, N D Cowell, A E V Lilley; Elsevier Science Publishing Co. Inc., New York, USA, 1990
3. Unit Operations of Chemical Engineering (5<sup>th</sup> Edition) by Warren L McCabe, Julian C Smith, Peter Harriott; McGraw-Hill, Inc., New Delhi, 1998
4. Unit Operations in Food Processing (2<sup>nd</sup> Edition) by R L Earle; Pergamon Press, Oxford, UK, 1992
5. Unit Operations of Agricultural Processing by K M Sahay and K K Singh; Vikas Publishing House Pvt Ltd., New Delhi, 2007

**FTP-271: CEREALS AND LEGUMES TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use Non-Programmable scientific calculator.**

**1. Wheat Technology:**

Evaluation of properties of Wheat and milled products, Physical, Chemical and

Rheological.

Experiment baking bread, biscuit, cakes, and pastries.

Evaluation of baked bread.

Experimental milling of wheat.

**2. Rice Technology –evaluation of properties of rice, physical and chemical-**

Cooking quality of rice.

Experiment on parboiling, evaluation of quality.

Milling of rice, assessment of degree of polishing,

Evaluation of extruded products.

Milling of pulses.

**3. Legumes Technology-**

Evaluation of properties of legumes (Physical, Chemical and cooking)

Production of isolates and Concentrates

Production of different soybean products. Evaluation

and Production of extruded products

**4. Industrial Visit.**

**FTP-272: FRUITS AND VEGETABLES TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Preparation of fruit juices, squash, R-T-S, Nectar.
2. Preparation of jam, jelly, marmalade preserve, candied.
3. Preparation of fruit juice concentrate and powder.
4. Preparation of tomato products.
5. Preparation of pickles, chutneys, sauces.
6. Dehydration of fruits and vegetables.
7. Freezing of fruits and vegetables.
8. Quality control of processed products.
9. Can seaming operation and canning of fruits and vegetables.

**FTP-273: INDUSTRIAL MICROBIOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

Production, recovery and control tests for the following fermentation products.

1. Alcohol
2. Baker's yeast
3. Citric acid
4. Glutamic acid
5. Amylases
6. Pectinase
7. Wine
8. Cider
9. Miso
10. Tempeh
11. Yoghurt
12. Riboflavin

**FTP- 276: SUGAR INDUSTRY CO PRODUCTS**

**Credits: 0-0-2**

1. Analysis of Molasses for:
  - a) Bx (%), Pol (%) and Purity
  - b) Ash (%)
  - c) Reducing sugar (%)
  - d) Total sugars
2. Analysis of Sugarcane for:
  - a) Pol (%)
  - b) Fibre( %)
3. Analysis of Bagasse for:
  - a) Pol (%)
  - b) Moisture (%)
4. Analysis of Press Mud for:
  - a) Pol (%)
  - b) Moisture( %)
5. Sieving and Grading of Sugar.
6. Preparation of seed slurry by:
  - a) Precipitation method
  - b) Grinding method.
7. Colour measurement using spectrophotometer by ICUMSA method in
  - a) White sugar
  - b) Raw sugar
8. Analysis of Gur for:
  - a) Bx (%), Pol (%) and Purity
  - b) Ash( %)
  - c) Reducing sugar (%)
  - d) Total sugars
9. Determination of turbidity of Juice using Nephelometer
10. Analysis of Electrolytic Chlorine
11. Analysis of Ammonium bifluoride
12. Analysis of Commercial formalin
13. Visit to a sugar/distillery/Brewery

**Recommended Books:**

1. System of Technology Control for Cane Sugar Factories in India, Ist edition, N.C.Varma.
2. Sugar Analysis by Zerban and Brown IIIrd edition published by John Wiley and Sons.
3. Handbook of Cane Sugar Technology, IInd edition, R.B.L. Mathur.

**FTP-274: MECHANICAL OPERATIONS**

**Credits: 0-0-2**

**Note: Students can use Non-Programmable scientific calculator.**

1. Study of working principle and operation of various types of grinders.
2. Study of working principle and operation of various types of crushers.
3. Sieve analysis to determine particle size of flour sample.
4. Design calculations of belt conveyor.
5. Design calculations of screw conveyor
6. Design calculations of bucket elevator.
7. Study of filtration operation.
8. Study of mixing operation.
9. Visit to a food industry.

**FTL-301: DAIRY TECHNOLOGY****Credits: 3-1-0****Note: Students can use the Non-Programmable scientific calculator.****UNIT-I**

1. Chemical composition, nutritive value and physico-chemical characteristics of milk.
2. Microbiology of Milk.
3. Processing of liquid milk- methods of milk collection, filtration, pasteurization, homogenization, packaging .
4. Special milks.
5. Synthetic milk and its detection.
6. Various analytical techniques of determination of milk quality.

**UNIT-II**

7. Chemistry and technology of cream, butter, margarine and ghee manufacture
8. Production of ice cream and other frozen desserts.
9. Chemistry and technology of: a) Evaporated milk b) Condensed milk
10. Chemistry and Technology of Milk Powders (full fat, Skim-milk and instantized milk powders).

**UNIT-III**

11. Technology of cheese and other fermented milk products.
12. Indigenous milk products and their technology.
13. Fortification of milk products with different nutrients.
14. Byproducts of dairy industry.
15. Milk plant hygiene, sanitation and waste utilization.

**Recommended Books:**

1. Technology of Dairy Products by Early, R.
2. Outlines of Dairy Technology by De. S.
3. Chemistry and Testing of Dairy Products by Atherten.

**FTL-302: FISH, MEAT AND POULTRY TECHNOLOGY**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Development of meat and poultry industries in India. Ante-mortem examination of animals and poultry birds. Slaughter and dressing, post-mortem examination. Post-mortem changes in meat and factors affecting them. Nutritive value of meat. Whole sale and retail cuts. Meat tenderization methods. Communitied meat products.

**UNIT-II**

Canning of meat and meat products, Restructured meat products, sausages, curing and smoking of meat. Disposal and utilization of meat industry by- products. Modified atmospheric packaging of meats. MFPO and sanitation of abattoir.

**UNIT-III**

Structure, composition and nutritive value of poultry eggs. Poultry dressing, Functional properties of eggs, internal quality of eggs and its preservation. Eggs spoilage, Spray dried and frozen egg products. Fish structure and composition. Cold storage, freezing preservation and canning of fish. Picking of fish, fish protein concentrates, fish meal and by products of fish processing industry.

**Recommended Books:**

1. Meat, Poultry and Sea Food Technology - R.L. Henricksons.
2. Meat Hand Book -Albert Lovie.
3. Poultry Products Technology - G.J. Mountney.
4. Fish as Food (Vol. I, II, III, IV) - George Borgstorm.
5. Fish Technology - R.J. Roberts.



**FTL-303: FATS AND OIL TECHNOLOGY**

**Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Status of oils and fats and Indian Economy.

General chemistry, Analytical methods for characterization.

Quality standards of edible oils and fats.

**UNIT-II**

Antioxidants and rancidity, oil and fats in diet, nutrition and disease.

Detection of adulteration. Extraction and clarification of vegetable oil.

Modifications of the properties of oils and fats including chemical processes.

**UNIT-III**

Confectionery plastic fats, preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products, low calorie spreads, Animal fat, oil derivatives.

Technology of oilseed protein isolate.

**Recommended Books:**

1. Fats and Oil - Bailey.
2. The Chemistry and Technology of Edible Oils and Fats, P.N. Williams and J. Devine.

**FTL-306: MASS TRANSFER****Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Theory of diffusional processes - molecular diffusion in fluids, measurement of diffusivity.

Theory of interphase mass transfer, mass transfer coefficients and mass transfer theories.

Analogies between heat, mass and momentum transfer.

**UNIT-II**

**Crystallization and absorption:** Theory of crystallisation, material and energy balance calculations, introduction to crystallizer design. Introduction to the principles of absorption.

**Distillation:** Vapor-Liquid equilibria, relative volatility batch and equilibrium distillation, steam distillation, molecular distillation, azeotropic and extractive distillation, enthalpy concentration diagram. Theory of rectification column design.

**UNIT-III**

**Extraction:** Fundamental principles of liquid - liquid extraction, selectivity, and choice of solvent. Material balances in stage operations and principles of the graphical methods in determination of number of equilibrium stage.

Fundamental principles of leaching operation and material balance calculations.

**Recommended Books:**

1. Unit Operation in Chemical Engineering – McCabe and Smith.
2. Mass Transfer – Traybel.
3. Chemical Engineering – Coulson and Richardson

**FTL-307: COMPUTER APPLICATIONS IN FOOD INDUSTRY****Credits: 3-1-0****UNIT -I**

Computerization, Importance of Computerization in food industry and IT applications in food industries.

Computer operating environments and information system for various types of food industries.  
Introduction to a Barcharts and Piecharts and the procedure to develop a barchats and piecharts on given Data.

Introduction to Software and Programming Languages, Properties, Differences of an Algorithm and Flowcharts, Advantages and disadvantages of Flowcharts and Algorithms.

Introduction, Fundamentals and advantages of „C  
Steps in learning „C (Character set, Identifiers, Keywords)  
Steps in learning „C (Data types, Constants, Variables, Escape sequences) IT Applications in Food Industry

Steps in learning C (Operators, Statements)  
Steps in learning „C (Header Files, Input and Output functions:  
Formatted I/O functions Unformatted I/O functions)

**UNIT-II**

Basic Structure of a simple „C program  
Decision Making/Control Statements (If statement, if else statement, ladder if statement, switch statement)  
Branching, Concept of Looping and Looping statements (for loop, do while loop)  
Concept of Arrays and Types of Arrays (Single, Double and Multi dimensional Arrays)

**UNIT-III**

Concept of Functions (Defining a function and Function Prototypes,  
Types of functions: Library functions and User defined functions)  
Concept of various types of User Defined Functions (i.e., About 4 types)  
Concept of a String Library Functions  
Concept of Pointers, Structures and Unions  
Introduction to a Data Structures

**FTP-321: DAIRY TECHNOLOGY**

**Credits: 0-0-2**

*Note: Students can use the Non-Programmable scientific calculator.*

1. Quantitative estimation of milk constituents such as moisture, % TS, ash, and fat.
2. Determination of titrable acidity of milk.
3. Determination of specific gravity of milk and observe effect of water addition on it.
4. Performance of platform tests on given sample of milk.
5. Detection of adulterants and preservatives in milk.
6. Determination of bacteriological quality of milk.
7. Preparation of sterilized flavored milk.
8. Preparation of
  - a) Dahi
  - b) Butter
  - c) Ghee
  - d) Ice Cream
  - e) Paneer and Chhana
  - f) Milk Powder
  - g) Khoa
9. Visit to milk processing plant.

**FTP-322: FISH, MEAT AND POULTRY TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Determination of egg constituents such as ash/ Total solid/ moisture.
2. Determination of Specific gravity of eggs.
3. Determination of internal quality of eggs.
4. Determination of Haugh units of eggs.
5. Preparation of egg pickle.
6. To determine effect of different time and temperature combination condition on formation of iron sulfide in eggs.
7. To study slaughtering and dressing of poultry bird.
8. To make retail cuts of dressed chicken and calculating percentage yields.
9. To determine meat to bone ratio of chicken.
10. Preparation of comminuted meat products.
11. Preparation of meat block.
12. Dressing of fish and calculation of dressing percentage.
13. To determine meat to bone ratio of fish meat.
14. Preparation of comminuted fish products.

**FTP-323: FATS AND OIL TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Experimental expeller processing of oilseeds.
2. Solvent extraction process.
3. Determination of Iodine value, saponification value, R.M. value, Kirschner, Polenski value, melting point and peroxide value of fats and oils sample.
4. Adulterants in fats and oils.
5. Imitated dairy products, margarine etc.
6. Production of protein concentrates and isolates.
7. Determination of anti-oxidant-used in oil.

**FTP-326: COMPUTER APPLICATIONS IN FOOD INDUSTRY**

**Credits: 0-0- 2**

1. Application of MS Excel to solve the problems of food technology  
Introduction to a C compiler and How to handle the C compiler (Controllers used in C Compiler)
2. Statistical quality controls of food Developing and executing simple C programs  
(By using various operators used in "C").
3. *Sensory Evaluation of food* Developing and executing simple "C" programs  
(By using some mathematical and logical operation)
4. Chemical kinetics in Food processing Developing and executing simple "C" programs  
(By using Control statements: if, if-else, multiple if-else)
5. Use of Word Processing software (MS- Power Point) for creating reports and presentation  
Developing and executing simple "C" programs  
(By using Control statements: nested if "s, conditional operator, and switch statements)
6. Familization with the application of computer in food industries  
Developing and executing simple "C" programs (By using loops: while, do- while loops)
7. Milk plant, dairy units, fruit and vegetable processing unit familization with software related to food industries. Developing and executing simple "C" programs (By using loops: for loop)
8. Ergonomics application in the Food industries. Developing and executing simple "C" programs (By using arrays: single (or) one dimensional arrays)
9. Developing and executing simple "C" programs (By using arrays: two dimensional arrays)
10. Developing and executing simple "C" programs (By using four types of Functions)
11. Developing and executing simple "C" programs (By using a string functions: strlen( ),  
strrev( ), strcpy( ))
12. Developing and executing simple "C" programs  
(By using a string functions: strcat( ), strlen( ),strupr( ))
13. Developing and executing simple "C" programs (By using structures, unions)

**Recommended Books:**

1. Let us "C" – Yeswanth Kanethkar
2. Computer Programming in „C – E. Balaguruswamy
3. Data Structures – Mark Allen Waise
3. M. S Excel 2000 - Microsoft Corp.
4. M. S. Office – Microsoft Corp
5. Computer Concepts for Agri Business – M.V. Verton, AVI Pub. Corp, West Port, USA.

**FTL-351: FOOD REGULATIONS AND QUALITY CONTROL**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Introduction, objective and importance of general principles of quality control, Quality attributes - color, gloss, viscosity and consistency, size and shape and texture. Flavor and Taste. Introduction to sensory evaluation of foods. Different sensory evaluation techniques.

**UNIT-II**

Good Manufacturing Practices, Micro analytical and microbiological methods of quality evaluation. Govt. and Trade standards for quality. Concept of quality circles, Importance and objectives, Six sigma concept, Codex Alimentarius, ISO.

**UNIT-III**

Foods Laws and Regulations - Food Safety and Standards Act, 2006, Agricultural Product Act 1937 (AGMARK); Technical Standardization Committee (TSC) 1944 (Army); Fruit Product Order (FPO), 1955; Prevention of Food adulteration Act (PFA) 1954; and Rules there of, 1955; Sugar Control Order 1966, Export (Quality Control and Inspection) Act 1963 and Rules 1964; Meat Food Products Order, 1974 ; Bureau of Indian Standards (Certification Marks) Act, 1952. The Consumers' Protection Act, 1986. Solvent Extracted oil, de-oiled Meal and Edible flours (Control) Order, 1967; Vanaspati (Control) Order, 1978. Recording and Reporting of quality. Introduction to Statistical quality control.

**Recommended Books:**

1. Advances in Food Research - By Academic Press.
2. Quality Control for Food Industry - By Krammar and Twigg.
3. Quality Control in Food Industry - By S.N. Herschdoarfar.



**FTL-352: APPLICATIONS OF ENZYMES IN FOOD INDUSTRY**

**Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

1. General properties and classification of enzymes. Co-enzymes, cofactors, enzymes inhibitors. Enzyme kinetics, factors affecting enzyme action
2. Enzyme kinetics, factors affecting enzyme action.
3. Immobilized enzymes.
4. Sources of enzymes and their production.

**UNIT-II**

5. Role of enzymes in meat tenderization
6. Significance of enzymes in starch industry- high fructose corn syrups, glucose syrups, monohydrate dextrose.
7. Application of amylases, proteases, lipoxidase, lipases and pentosanes in baking industry.

**UNIT-III**

8. Applications of enzymes in milk and milk products.
9. Enzymes in fruits and vegetables processing-clarification and debittering.
10. Enzymes in beer and wine making

**Recommended Books:**

Food Enzymes by Reed.

**FTL-353: BIOCHEMICAL ENGINEERING**

**Credit: 2-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

- 1. Introduction:** Introduction to biochemical engineering, chemical engineering, microbiology, biotechnology and biochemistry.
- 2. Cell growth:** Introduction, quantifying cell concentration, growth patterns and kinetics in batch culture, effect of environmental conditions on growth kinetics, heat generation by microbial growth.

**UNIT-II**

- 3. Enzymes:** Production of crude enzyme, isolation and purification, immobilized enzymes and bio-reactor. Immobilization techniques, kinetics, industrial application and product recovery.
- 4. Enzyme kinetics:** Introduction, mechanistic models for simple enzyme kinetics, Michaelis-Menten type kinetics, effects of pH and temperature.

**UNIT-III**

- 5. Fermenter design, control and scale up:** Aeration and agitation in fermenter, oxygen supply and demand in microbial processes - single and multiple bubble aeration, oxygen transfer in fermentation, types of spargers, etc.
- 6. Continuous fermentation.**

**Recommended Books:**

1. Bioprocess Engineering: Basic Concepts by M.L. Shuler and F. Kargi, PHI Learning Private Limited, New Delhi.
2. Biochemical Engineering by D.G. Rao, McGraw Hill Publishing Co. Ltd.
3. Fundamentals of Biochemical Engineering by A.V.N. Swamy, BS Publications.
4. Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment by H.C. Vogel and C.L. Todaro, Standard Publishers Distributors, Delhi

**FTL-354: PACKAGING TECHNOLOGY**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

1. Definition, Functions of Food package
2. Hazards acting on package during transportation.
3. Various packaging materials - rigid, semi rigid and flexible
4. Principles of manufacture, properties, types and uses of - wood, paper, paper-board, corrugated fiber board
5. Plastic, metal and glass in food packaging

**UNIT-II**

6. Laminates and coextruded films.
7. Special packaging methods: Retortable packaging, Aseptic, vacuum, shrink packaging.
8. Free oxygen scavenging packaging.
9. Modified and controlled atmosphere packaging.
10. Shelf life prediction.

**UNIT-III**

11. Edible films and coatings
12. Packaging requirements of different products:  
Dairy products, Flesh foods, Cereal based foods, Fruits and vegetables, Beverages, Snack foods, Microwavable foods.
13. Safety and legislative aspects of packaging.

**Recommended Books:**

1. Fundamentals of Food Packaging by F.A. Paine.
2. Packaging of Food Beverages by F.T. Day.
3. Food Packaging by Saccharow and Griffith.
4. Flexible Packaging of Foods by A.L. Brandy.
5. Principles of Food Packaging by R. Heiss.

**FTL –357: HUMAN RESOURCES MANAGEMENT IN FOOD INDUSTRY**

**Credits: 3–0–0**

**UNIT-I**

Introduction to Human Resource Management and its definition, Functions of Human Resource Management and its relation to other Managerial functions, Importance of human resource management in Industry. Need for Human Resource Planning, Process of Human Resource Planning, Methods of Recruitment and Interviews. Meaning and Importance of Placement and Induction, Job satisfaction and its Importance.

**UNIT-II**

Training and Development: Difference between Training and Development, Principles of Training, Employee Development, Promotion Merit V/s. Seniority Performance appraisal. Job satisfaction and its importance. Motivation, Factors affecting motivation, Introduction to Motivation theory, Quality of Working life. Grievances and Grievance Handling Procedure, Discipline and Disciplinary action. Human Relations and Industrial Relations, Differences between Human Relations and Industrial Relations, Factors required for Good Human Relations policy in Industry.

**UNIT-III**

Employee-Employer relationship, Causes and effects of Industrial disputes; Prevention and settlement Machinery of Industrial Disputes in India; Importance of Collective Bargaining, Role of Trade Unions in maintaining Cordial Industrial Relations. Maintenance: Meaning and importance of Employees Safety Accidents-Causes, Preventions, Safety provisions under the Factories Act, 1948. Welfare of Employees and its importance, Provisions under the Factories Act. Social Security, its meaning, importance, Steps taken by Government of India; Future challenges for Human Resource Management.

**Recommended Books:**

1. Personnel Management : C B Mamoria
2. Principles of Personnel Management : Dawin B Filppo
3. Labour Problems and Social Welfare : R C Saxena
4. Principle and Practice of Marketing in India : CB Mamoria and RC Joshi

**FTP-371: FOOD REGULATIONS AND QUALITY CONTROL**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Estimation of moisture content of food sample.
2. Estimation of ash content of food sample.
3. Estimation of extraneous matter present in food sample.
4. Recognition of threshold concentration of primary taste.
5. Recognition of the flavor of food sample.
6. Determination of water activity of food sample.
7. Determination of color of food sample using Hunter Colorimeter.
8. Determination of viscosity of given food sample.
9. Preparation and sensory evaluation of food sample (cookies).
10. Detection of adulteration of desi ghee with vanaspati.
11. Detection of adulterants in milk.
12. Detection of preservatives such as boric acid, borate, carbonates, bicarbonates in milk.
13. Quality control tests in milk.
14. Quality examination of canned food sample

**FTP-372: BIOCHEMICAL ENGINEERING**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Preparation of culture media.
2. Demonstration of bacterial growth in batch cultures.
3. Heat inactivation of enzyme, calculation of rate constants, thermal death rate, etc.
4. Measurement of mass transfer coefficient ( $K_La$ ) by dynamic method, effect of air flow rate and r.p.m.
5. Determination of total dissolved solids in water.
6. Measurement of dissolved oxygen.
7. Measurement of B.O.D.
8. Measurement of C.O.D.
9. Introduction to fermentation operation, instrumentation etc.
10. Layout of fermentation technology.

**FTP-373: PACKAGING TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Identification of different types of packaging material.
2. Physical properties of packaging films.
3. Determination of water absorption of paperboard and CFB
4. Uniformity and amount of wax determination.
5. Chemical resistance of packaging material
6. WVTR of different packaging material.
7. Grease resistance of packaging material.
8. Packaging of fresh foods I) Fruits and Vegetables.
9. Determination of tin coating weight and porosity.
10. Determination of continuity of lacquer coating.
11. Determination of tensile strength and heat seal strength of packaging material.
12. To conduct drop test.
13. Estimation of shelf life of packaged foods.

**FTL-401: FOOD PROCESS ENGINEERING**

**Credits: 3-1-0**

**Note: Students can use Non-Programmable scientific calculator.**

**UNIT-I**

**1. Refrigeration**

Selection of refrigerant, components of refrigeration systems, pressure-enthalpy charts and mathematical expressions useful in analysis of vapour compression refrigeration.

**2. Freezing**

Different types of food freezing systems - indirect contact systems and direct contact systems, freezing time calculations.

**UNIT-II**

**3. Evaporation**

Boiling point elevation, types of evaporators, design of single effect and multi effect evaporator, steam economy, vapour recompression systems – thermal recompression, mechanical recompression.

**4. Extrusion**

Types of extruders – single screw extruder, twin screw extruder and their classification, design features and operational characteristics.

**UNIT-III**

**5. Drying**

Theory of drying, bound moisture, free moisture, equilibrium moisture content, critical moisture content, drying rate curves. Engineering aspects of different types of driers including bin drier, tray drier, drum drier, tunnel drier, spray drier, fluidized bed drier, freeze drier.

**Recommended Books:**

1. Introduction to Food Engineering (3<sup>rd</sup> Edition) by R. Paul Singh and Dennis R. Heldmann; Academic Press, London, UK.
2. Unit Operations of Chemical Engineering (5<sup>th</sup> Edition) by Warren L. McCabe, Julian C. Smith, Peter Harriott; McGraw-Hill, Inc., New Delhi.
3. Transport Processes and Unit Operations (3<sup>rd</sup> Edition) by Christie J. Geankoplis, Prentice-Hall of India Pvt. Ltd., New Delhi.
4. The Technology of Extrusion Cooking by N.D. Frame, Blackie Academic and Professional, Madras.



**FTL- 402: CONFECTIONERY TECHNOLOGY**

**Credits: 3-1-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

Sugar, glucose and invert syrup and sugar free sweeteners, crystalline and non crystalline confectionary, fondant, hard boiled candy, caramel, toffee, fudge, nut brittles, krokant, praline, truffles, pulled sugar, marshmallows.

**UNIT-II**

Fruit chews, jellies, gums, pastilles, turkish delight, marzipan, lozenges, panning.

Defects in confectionary: sugar bloom.

Chewing gum and bubble gum. Packaging requirements of sugar confectionary.

**UNIT-III**

Chocolate confectionary: Processing of cocoa beans. Chocolate refining, conching and molding, enrobing, panning. Ingredients used in chocolate. Cocoa butter substitutes. Fat bloom. Packaging requirements of chocolate confectionary.

**Recommended Books:**

1. The Science of Sugar Confectionary by W.P. Edwards, RSC Publishers.
2. The Science of Chocolate by Stephent Becett, RSC Publisher.
3. Chocolate, Cocoa and Confectionary Science and Technology by Bernard W. Minifie.

**FTL-403: SPICES AND FLAVOUR TECHNOLOGY**

**Credits: 3-0-0**

**Note: Students can use the Non-Programmable scientific calculator.**

**UNIT-I**

1. Production of spices in India. Chemical composition of spices. Properties of spices and spice products.

**UNIT-II**

2. Spice Processing : Production of whole, ground, essential oil, oleoresins and encapsulated spices from raw spices. Quality standards for processed spices and their products.

**UNIT-III**

3. Flavour Technology - Physiology of flavor. Classification of flavouring compounds. Production of compound flavouring. Standards for compound flavourings. Instrumental and sensory analysis of flavourings.
4. Flavour Application: Factor affecting stability of flavourings in foods. Incorporation of spices and compound flavourings in food products.

**Recommended Books:**

1. Handbook of Herbs and Spices, Vol 3, K.V.Peter, Wood Head Publishing, Combridge, UK 2004.
2. Spice Statistics- Spice Board, Govt. of India, Ministry of Commerce, Cochin, India
3. Spice and Seasonings., A Food Technology Handbook - DR Tainter and A.T.Grenis, VCH, Publishing Co. 2003.

**FTL-404: FOOD PROCESSING PLANT LAYOUT AND DESIGN**

**Credits: 3-0-0**

**Note: Students can use Non-Programmable scientific calculator.**

**UNIT-I**

**Plant Location**

Concept and factors governing plant location. Locational economics – comparison of rural vs urban plant sites, plant site selection guide.

**Plant Layout**

Classes of layout problems, objectives, principles and types of layouts – process layout, product layout, combination layout, fixed position layout; methods and tools of plant and factory layouts; plant layout procedures.

**Factory Building**

Considerations in building design, types of factory buildings, building construction materials for floors, walls, roofs, etc.

**UNIT-II**

**Network Analysis of Processes**

Basic terms, objectives and advantages of network analysis, various network techniques, PERT and CPM techniques, smoothing.

**Cost Analysis**

Fixed cost, variable cost, depreciation, methods of economic analysis, profitability analysis of a plant.

**UNIT-III**

**Layouts**

Layouts of different types of food and fermentation industries – canning, dairy, bread, biscuit, beer, tomato processing, rice mill and wheat mill.

**Plant Maintenance**

Objectives and importance of maintenance, types of maintenance – corrective or breakdown

Maintenance, scheduled maintenance, preventive maintenance and predictive maintenance.

**Recommended Books:**

1. Plant Layout and Design by James M. Moore, The Macmillan Company, New York.
2. Industrial Engineering and Management by O.P. Khanna, Dhanpat Rai Publications (P) Ltd., New Delhi.

**FTP-421: FOOD PROCESS ENGINEERING**

**Credits: 0-0-2**

**Note: Students can use Non-Programmable scientific calculator.**

1. Study of dehydration characteristics of food material using cabinet drier.
2. Study of dehydration characteristics of food material using fluidized bed drier.
3. Study the working principle and operation of freeze drier.
4. Study the working principle and operation of spray drier.
5. Study of psychometrics – use and applications.
6. Study the working principle and operation of an evaporator.
7. Study of design parameters and refrigeration load capacity of a cold storage plant.
8. Determination of freezing time of selected food materials.
9. Study the working principle and operation of an extruder.
10. Visit to a food industry.

**FTP-422: CONFECTIONERY TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

To study the preparation of confectionary products

1. Fondant
2. Hard boiled candy
3. Caramel
4. Toffee
5. Butterscotch
6. Pulled sugar
7. Jellies, gums
8. Visit to Confectionery Industry

**FTP-423: SPICES AND FLAVOUR TECHNOLOGY**

**Credits: 0-0-2**

**Note: Students can use the Non-Programmable scientific calculator.**

1. Spice analysis.
2. Identification of whole spices.
3. Determination of Essential oil in spices.
4. Detection of Adulteration in Spices
5. Sensory analysis of flavored foods.
6. Correlation of subjective and objective methods
7. Formulation of compound flavorings.
8. Application of spices and compound flavorings in processed food products.
9. Visit to Spice Processing Unit.

**FTP-424: SEMINAR AND GROUP DISCUSSION**

**Credits: 0-0-2**

**FTP-451: INDUSTRIAL TRAINING**

**Credits: 0-0-20**

Students will be required to undertake Practical Training in Industrial establishment in the 8<sup>th</sup> semester of B.Tech.(Food Tech.) and will have to submit a Industrial Training Report along with original certificate at the completion of the training. Every student will be required to submit a training report in typed standard prescribed format. The objective of the industrial training is to test the ability of the student to grasp the industrial environment in the field of food processing. Every student will be orally examined in the context of the training report.