

FACULTY OF SCIENCES

SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

B.TECH. FOOD SCIENCE & TECHNOLOGY (FOUR YEARS DEGREE)

(SEMESTER: I - VIII)

Examinations: 2020-24



GURU NANAK DEV UNIVERSITY AMRITSAR

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**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER SYSTEM)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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-197	C	Engineering Chemistry	3	-	-	3
ENL-101	C	Communicative English-I	2	-	-	2
PBL-121 /	C	ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-I OR	2	-	-	2
PBL-122/		*ਮੁੱਢਲੀ ਪੰਜਾਬੀ-I OR				
HSL-101		*Punjab History & Culture (1450-1716)				
FTL-173	C	Engineering Graphics & Drafting	2	1	1	4
FTP-121	C	Experiments in Manufacturing Processes	-	-	2	2
FTP-122	C	Experiments in Principles of Food Preservation	-	-	2	2
CYP-196	C	Experiments in Chemistry (Practical)	-	-	2	2
SOA-101	C	Drug Abuse: Problem, Management and Prevention (Compulsory ID Course)	2	-	-	2
Total Credits:			19	2	7	28

***Special Note:**

- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Domicile/Non-Domicile of Punjab** ਹਨ ਅਤੇ ਉਨ੍ਹਾਂ ਨੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਵਿਦਿਆਰਥੀ ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ) ਪੜ੍ਹਨਗੇ।
- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Non-Domicile of Punjab** ਹਨ ਅਤੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਨਹੀਂ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਜਾਂ ਪੰਜਾਬ ਹਿਸਟਰੀ ਐਂਡ ਕਲਚਰ ਵਿੱਚੋਂ ਕੋਈ ਇੱਕ ਵਿਸ਼ਾ ਚੁਣ ਸਕਦੇ ਹਨ।
- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Domicile of Punjab** ਹਨ, ਪੰਤੂ ਕਿਸੇ ਕਾਰਣ ਪੰਜਾਬ ਤੋਂ ਬਾਹਰ ਪੜ੍ਹੇ ਹਨ ਅਤੇ ਉਨ੍ਹਾਂ ਨੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਨਹੀਂ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਦਾ ਹੀ ਵਿਸ਼ਾ ਪੜ੍ਹਣਗੇ।
- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Domicile of Punjab** ਹਨ ਅਤੇ ਪੰਜਾਬ ਦੇ ਕੇਂਦਰੀ ਵਿਦਿਆਲਿਆ ਜਾਂ ਕਿਸੇ ਹੋਰ ਸਕੂਲ ਵਿੱਚ ਪੜ੍ਹੇ ਹਨ ਅਤੇ ਕਿਸੇ ਕਾਰਣ ਉਨ੍ਹਾਂ ਨੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਨਹੀਂ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਦਾ ਵਿਸ਼ਾ ਹੀ ਪੜ੍ਹਣਗੇ।

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (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-II	2	-	-	2
PBL-131 / PBL-132 / HSL-102	C	ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-II OR *ਮੁੱਢਲੀ ਪੰਜਾਬੀ-II OR *Punjab History & Culture (1717-1947)	2	-	-	2
FTL-156	C	Industrial Microbiology	3	-	-	3
FTP-172	C	Experiments in Food Chemistry	-	-	2	2
FTP-176	C	Experiments in Industrial Microbiology	-	-	2	2
PSL-055	C	Human Rights & Constitutional Duties (Compulsory ID)	2	-	-	2
Total Credits:			18	2	4	24

***Special Note:**

- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Domicile/Non-Domicile of Punjab** ਹਨ ਅਤੇ ਉਨ੍ਹਾਂ ਨੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਵਿਦਿਆਰਥੀ ਪੰਜਾਬੀ (ਲਾਜ਼ਮੀ) ਪੜ੍ਹਨਗੇ।
- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Non-Domicile of Punjab** ਹਨ ਅਤੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਨਹੀਂ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਜਾਂ ਪੰਜਾਬ ਹਿਸਟਰੀ ਐਂਡ ਕਲਚਰ ਵਿੱਚੋਂ ਕੋਈ ਇੱਕ ਵਿਸ਼ਾ ਚੁਣ ਸਕਦੇ ਹਨ।
- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Domicile of Punjab** ਹਨ, ਪੰਤੂ ਕਿਸੇ ਕਾਰਣ ਪੰਜਾਬ ਤੋਂ ਬਾਹਰ ਪੜ੍ਹੇ ਹਨ ਅਤੇ ਉਨ੍ਹਾਂ ਨੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਨਹੀਂ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਦਾ ਹੀ ਵਿਸ਼ਾ ਪੜ੍ਹਣਗੇ।
- ਜਿਹੜੇ ਵਿਦਿਆਰਥੀ **Domicile of Punjab** ਹਨ ਅਤੇ ਪੰਜਾਬ ਦੇ ਕੇਂਦਰੀ ਵਿਦਿਆਲਿਆ ਜਾਂ ਕਿਸੇ ਹੋਰ ਸਕੂਲ ਵਿੱਚ ਪੜ੍ਹੇ ਹਨ ਅਤੇ ਕਿਸੇ ਕਾਰਣ ਉਨ੍ਹਾਂ ਨੇ ਅੱਠਵੀਂ/ਦਸਵੀਂ ਜਮਾਤ ਤੱਕ ਪੰਜਾਬੀ ਵਿਸ਼ਾ ਨਹੀਂ ਪੜ੍ਹਿਆ ਹੈ, ਉਹ ਮੁੱਢਲੀ ਪੰਜਾਬੀ ਦਾ ਵਿਸ਼ਾ ਹੀ ਪੜ੍ਹਣਗੇ।

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER SYSTEM)
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THIRD SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			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
ECL-210	C	Basic Electrical and Electronics Engineering	3	1	-	4
FTP-221	C	Experiments in Basic Microbiology	-	-	2	2
FTP-224	C	Experiments in Sugar Processing and Refining	-	-	2	2
ESL-220	C	Environmental Studies (Compulsory ID)	2	-	-	2
Total Credits:			17	2	4	23

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FOURTH SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-252	C	Cereals and Pulses Technology	3	1	-	4
FTL-253	C	Fruit and Vegetables Technology	3	1	-	4
FTL-255	C	Fluid Flow and Heat Transfer	3	1	-	4
FTL-256	C	Mechanical Operations	3	1	-	4
FTL-258	C	Sugar Industry Co-Products	3	-	-	3
FTP-271	C	Experiments in Cereals and Pulses Technology	-	-	2	2
FTP-272	C	Experiments in Fruit and Vegetables Technology	-	-	2	2
FTP-274	C	Experiments in Mechanical Operations	-	-	2	2
FTP-276	C	Experiments in Sugar Industry Co-Products (Lab)	-	-	2	2
Total Credits:			15	4	8	27

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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	1	-	4
FTL-306	C	Mass Transfer	3	-	-	3
FTL-307	C	Computer Applications in Food Industry	3	1	-	4
PSL-053	C	Human Rights and Constitutional Duties	2	-	-	2
FTP-321	C	Experiments in Dairy Technology	-	-	2	2
FTP-322	C	Experiments in Fish, Meat and Poultry Technology	-	-	2	2
FTP-323	C	Experiments in Fats and Oil Technology	-	-	2	2
FTP-326	C	Experiments in Computer Applications in Food Industry	-	-	2	2
Total Credits:			17	4	8	29

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SIXTH SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-351	C	Food Regulations and Quality Control	3	1	-	4
FTL-352	C	Application of Enzymes in Food Industry	3	-	-	3
FTL-353	C	Biochemical Engineering	3	-	-	3
FTL-354	C	Packaging Technology	3	1	-	4
FTL-357	C	Human Resource and Management in Food Industry	3	-	-	3
FTL-358	C	Sugar Industry (Technical Control and Design)	3	1	-	4
FTP-371	C	Experiments in Food Regulations and Quality Control	-	-	2	2
FTP-372	C	Experiments in Biochemical Engineering	-	-	2	2
FTP-373	C	Experiments in Packaging Technology	-	-	2	2
FTP-374	C	Experiments in Sugar Industry Design Lab	-	-	2	2
Total Credits:			18	3	8	29

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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	Confectionary 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	Experiments in Food Process Engineering	-	-	2	2
FTP-422	C	Experiments in Confectionary Technology	-	-	2	2
FTP-423	C	Experiments in Spices and Flavour Technology	-	-	2	2
FTP-424	C	Seminar and Group Discussion	-	-	2	2
Total Credits:			12	2	8	22

EIGHTH SEMESTER

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
FTL-451	A	Industrial Training (4 months i.e. Jan-April)	-	-	16	16
FTL-452	A	Research Project	-	-	4	4
Total Credits:			-	-	20	20

Last date for Submission of:

- i) Training report within two weeks after coming from training.
- ii) Research Project along with Project Report to be submitted by 30th June

FTL-102: MANUFACTURING PROCESSES

Credits: 3-1-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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

SECTION-A

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.

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.

Non-Ferrous Metals and Alloys: Introduction, Aluminum and its alloys, copper and its alloys, lead and its alloys, phosphors Bronze gun metal.

SECTION-B

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.

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.

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SECTION-C

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.

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.

SECTION-D

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.

Drilling Machine: Introduction, types of drilling machine, work holding devices, list of drilling machine operation, twist drill nomenclature.

Shaper and Planning Machines: Introduction, types of shaper and planner, list of shaper and planer operations, Planner vs shaper machine.

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

FTL-103: GRAIN HANDLING AND STORAGE TECHNOLOGY

Credits: 2-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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

SECTION-A

Principles of grain storage

Grain storage structures

Stored product pests- insects, rodents, fungi, their nature
and occurrence

SECTION-B

Pest control- Techniques of pesticides application and fumigations

Pesticide chemistry, their toxicology and residual analysis

Pest control measures and sanitation of mills

SECTION-C

Grain procurement and handling

Modern techniques of infestation control

SECTION-D

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.

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FTL-104: PRINCIPLES OF FOOD PRESERVATION

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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

SECTION-A

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

SECTION-B

Drying /dehydration, types of dryers
Irradiations, sources and mechanism and Microwave heating (Principle and working) Additives and chemical preservative

SECTION-C

Enzymes in Food processing
Freezing and cold storage of foods, factors effecting freezing types of freezing and freezers
Food Processing and malnutrition, restoration, enrichment, fortification and supplementation of foods

SECTION-D

Pickling and fermented products
Intermediate moisture foods
Food packaging – rigid and flexible, corrosion of container

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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-197

ENGINEERING CHEMISTRY

Credits: 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Students can use the Non-Programmable scientific calculator.

Section – A

Water Hardness: Common Impurities of water, methods of determination of hardness, Clark's test and complex metric (EDTA) method, Degree of hardness. Numerical based on hardness and EDTA method.

Water Hardness Related problems: Boiler troubles their causes, disadvantages and prevention: Formation of solids (Scale and Sludge), Carry over (Priming and Foaming), Corrosion and Caustic (Scale and Sludge) Embrittlement.

Water Treatment Techniques: Introduction about water purification techniques, steps involved in purification of water, Sedimentation, coagulation, Filtration and Sterilization, Chlorination Water Treatment.

Softening of Water: Lime-Soda Method, Zeolite Method and Deionization/Demineralization Methods, Numerical Problems based on Lime-Soda and Zeolite softening methods.

Section – B

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

Section – C

Polymers: Introduction about polymers, different types of polymers, Different methods of classification and constituents of polymers, Thermosets and Thermoplastics, Preparation, Properties and uses of polyethylene, PP, Bakelite, polyester and Nylon

Elastomers: Introduction about elastomers, different types of elastomers, vulcanization, Synthesis Rubbers viz. Buna-S, Buna-N, Butyl and neoprene rubbers.

Silicone Based Compounds: Introduction, Preparation of silicones, cross linked silicones, Silicon fluids or oils, Silicon elastomers, Silicon resins and their applications.

Section – D

Electrochemistry: Faraday's Laws, conductance, Arrhenius theory of ionization, molar conductance, transport numbers, electric potential difference for a galvanic cell, types of half cells, standard electrode potential, concentration cells.

Metal Ions in Biological Systems: Introduction, energy sources for life, non-photosynthetic processes Essential and trace elements on biological processes, Biological role of alkali and alkaline earth metal ions with special reference of Na^+ - K^+ Pump.

References:

1. Casetllan, G.W. Physical Chemistry 4th Edition Narosa, 2004.
2. Peter A. and Paula, J.de Physical Chemistry 10th Edition Oxford University Press (2014).
3. Concise Inorganic Chemistry by J. D. Lee, Fifth Edition
4. Engineering Chemistry by P.C. Jain & Monica Jain Dhanpat Rai Publishers, New Delhi.
5. Chemical Process Industries by R. Norris Shrive, Mcgraw Hill Ltd., New Delhi.

List of Practicals:

1. Find the strength of 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. Determine percentage of acetic acid in given sample of vinegar.
6. Determination of total Hardness of Water.
7. Determine the permanent and temporary hardness in the given sample of water.
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. Determination of Chlorine in bleaching powder.
11. To determine the strength of HCL by conductometrically.
12. To determine the strength of strong and weak acid conductometrically.
13. To determine the distribution coefficient of iodine between Cyclohexane and water
14. Determination of surface tension of a given liquid by drop number method by stalagmometer.
15. To Determine The Critical Micelle Concentration of A Soap (Sodium Laurate) by surface tension measurements.

References:

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

ENL-101 : COMMUNICATIVE ENGLISH-I

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

Time : 3 Hrs.

Marks : 50

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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:

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

Section–A

“Word List”, “Correct Usage of Commonly used words and Phrases” from the chapter “Vocabulary” given in *The Written Word* by Vandana R. Singh.

Section–B

Letter- writing as prescribed in *The Written Word* by Vandana R. Singh.
Report writing as prescribed in *The Written Word* by Vandana R. Singh.

Section–C

Section 1 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

Section–D

Section 2 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

PBL 121 : ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ - I

ਸਮਾਂ : 3 ਘੰਟੇ

ਕਰੈਡਿਟ : 2
 ਕੁਲ ਅੰਕ : 50

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇੱਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿੱਚ ਕਰ ਸਕਦਾ ਹੈ।

ਸੈਕਸ਼ਨ-ਏ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 ਕਵਿਤਾ ਭਾਗ : 1-4 ਕਵੀ
 (ਕਵੀ ਦਾ ਜੀਵਨ, ਕਵਿਤਾ-ਸਾਰ, ਵਿਸ਼ਾ-ਵਸਤੂ, ਕਾਵਿ-ਕਲਾ)
- II. ਗੁਰਮੁਖੀ ਔਰਥੋਗਰਾਫੀ ਦੀ ਜੁਗਤ (ਪੈਂਤੀ, ਮੁਹਾਰਨੀ, ਬਿੰਦੀ, ਟਿੱਪੀ ਤੇ ਅੱਧਕ); ਵਿਸਰਾਮ ਚਿੰਨ੍ਹ, ਸ਼ਬਦ ਜੋੜ (ਸ਼ੁਧ-ਅਸ਼ੁਧ)

ਸੈਕਸ਼ਨ-ਬੀ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 ਕਵਿਤਾ ਭਾਗ : 5-8 ਕਵੀ
 (ਕਵੀ ਦਾ ਜੀਵਨ, ਕਵਿਤਾ-ਸਾਰ, ਵਿਸ਼ਾ-ਵਸਤੂ, ਕਾਵਿ-ਕਲਾ)
- II. ਲੇਖ ਰਚਨਾ (ਜੀਵਨੀ-ਪਰਕ, ਸਮਾਜਕ ਅਤੇ ਚਲੰਤ ਵਿਸ਼ਿਆਂ ਉੱਤੇ) : 10 ਲੇਖ ਲਿਖਵਾਉਣੇ
 (ਕਲਾਸ ਵਿੱਚ ਅਤੇ ਘਰ ਲਈ ਅਭਿਆਸ)

ਸੈਕਸ਼ਨ-ਸੀ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 ਕਹਾਣੀ ਭਾਗ : 1-4 ਕਹਾਣੀਆਂ
 (ਕਹਾਣੀ ਦਾ ਵਿਸ਼ਾ-ਵਸਤੂ, ਸਾਰ, ਕਹਾਣੀ-ਕਲਾ)
- II. ਸ਼ੁੱਧ, ਅਸ਼ੁੱਧ : ਦਿੱਤੇ ਪੈਰ੍ਹੇ ਵਿੱਚੋਂ ਅਸ਼ੁੱਧ ਸ਼ਬਦਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਨਾ
 (15 ਪੈਰ੍ਹਿਆਂ ਦੇ ਸ਼ੁੱਧ ਅਸ਼ੁੱਧ ਅਭਿਆਸ ਕਰਵਾਉਣੇ)

ਸੈਕਸ਼ਨ-ਡੀ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 ਕਹਾਣੀ ਭਾਗ : 5-8 ਕਹਾਣੀਆਂ
 (ਕਹਾਣੀ ਦਾ ਵਿਸ਼ਾ-ਵਸਤੂ, ਸਾਰ, ਕਹਾਣੀ-ਕਲਾ)
- II. ਅਖਬਾਰੀ ਇਸ਼ਤਿਹਾਰ : ਨਿੱਜੀ, ਦਫ਼ਤਰੀ ਤੇ ਸਮਾਜਕ ਗਤੀਵਿਧੀਆਂ ਨਾਲ ਸੰਬੰਧਤ

ਸਹਾਇਕ ਪੁਸਤਕਾਂ

1. ਰਾਜਿੰਦਰਪਾਲ ਸਿੰਘ ਬਰਾੜ, ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਇਤਿਹਾਸ, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
2. ਬ੍ਰਹਮਜਗਦੀਸ਼ ਸਿੰਘ, ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਾਵਿ ਸਿਧਾਂਤ, ਇਤਿਹਾਸ ਅਤੇ ਪ੍ਰਵਿਰਤੀਆਂ, ਵਾਰਿਸ ਸ਼ਾਹ ਫਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
3. ਬਲਦੇਵ ਸਿੰਘ ਧਾਲੀਵਾਲ, ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਇਤਿਹਾਸ, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
4. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਸਫ਼ਰ ਤੇ ਸ਼ਾਸਤ੍ਰ ਭਾਗਾਂ, ਸਿੰਘ ਬ੍ਰਦਰਜ਼, ਅੰਮ੍ਰਿਤਸਰ।
5. ਹਰਕੀਰਤ ਸਿੰਘ ਤੇ ਗਿਆਨੀ ਲਾਲ ਸਿੰਘ, ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਣ, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ, ਚੰਡੀਗੜ੍ਹ।
6. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸਿਧਾਂਤ ਤੇ ਵਿਹਾਰ, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
7. ਮਿੰਨੀ ਸਲਵਾਨ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਮੁੱਢਲੇ ਸੰਕਲਪ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
8. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਬੋਧ, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਅੰਮ੍ਰਿਤਸਰ।

PBL-122 : ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(Special paper in lieu of Punjabi Compulsory)

ਸਮਾਂ : 3 ਘੰਟੇ

ਕਰੈਡਿਟ : 2
 ਕੁਲ ਅੰਕ : 50

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇੱਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਸੈਕਸ਼ਨ-ਏ

ਪੈਂਤੀ ਅੱਖਰੀ : ਅੱਖਰ ਕ੍ਰਮ, ਮਾਤ੍ਰਾਵਾਂ
 (ਮੁੱਢਲੀ ਜਾਣ-ਪਛਾਣ)
 ਲਗਾਖਰ (ਬਿੰਦੀ, ਟਿੱਪੀ, ਅੱਧਕ) : ਪਛਾਣ ਤੇ ਵਰਤੋਂ

ਸੈਕਸ਼ਨ-ਬੀ

ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ : ਮੁੱਢਲੀ ਜਾਣ-ਪਛਾਣ
 ਸਾਧਾਰਨ ਸ਼ਬਦ, ਸੰਯੁਕਤ ਸ਼ਬਦ, ਮਿਸ਼ਰਤ ਸ਼ਬਦ
 ਮੂਲ ਸ਼ਬਦ, ਅਗੇਤਰ ਅਤੇ ਪਿਛੇਤਰ

ਸੈਕਸ਼ਨ-ਸੀ

ਸ਼ੁੱਧ ਅਸ਼ੁੱਧ : ਦਿੱਤੇ ਪੈਰ੍ਹੇ ਵਿੱਚੋਂ ਅਸ਼ੁੱਧ ਸ਼ਬਦਾਂ ਨੂੰ ਸ਼ੁੱਧ ਕਰਨਾ
 ਸਮਾਨਾਰਥਕ ਤੇ ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ

ਸੈਕਸ਼ਨ-ਡੀ

ਹਫ਼ਤੇ ਦੇ ਸੱਤ ਦਿਨਾਂ ਦੇ ਨਾਂ, ਬਾਰ੍ਹਾਂ ਮਹੀਨਿਆਂ ਦੇ ਨਾਂ, ਰੁੱਤਾਂ ਦੇ ਨਾਂ,
 ਇਕ ਤੋਂ ਸੌ ਤੱਕ ਗਿਣਤੀ ਸ਼ਬਦਾਂ ਵਿਚ

ਸਹਾਇਕ ਪੁਸਤਕਾਂ

1. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
2. ਮੁੱਢਲੀ ਪੰਜਾਬੀ, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
3. ਮਿੰਨੀ ਸਲਵਾਨ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਮੁੱਢਲੇ ਸੰਕਲਪ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।

HSL-101 : PUNJAB HISTORY & CULTURE (1450-1716)
(Special paper in lieu of Punjabi Compulsory)

Time : 3 Hrs.

Credits: 2-0-0
Marks : 50

Mid Semester Examination: 20% Weightage
End Semester Examination: 80% Weightage

Instructions for the Paper Setters

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Land and the People.
2. Bhakti Movement

SECTION-B

3. Life and Teaching of Guru Nanak Dev.
4. Contribution of Guru Angad Dev, Guru Arjun Dev, Guru Amar Das and Guru Ram Das.

SECTION-C

5. Guru Hargobind.
6. Martyrdom of Guru Teg Bahadur

SECTION-D

7. Guru Gobind Singh and the Khalsa.
8. Banda Singh Bahadur: Conquests and Execution.

Suggested Reading

1. Kirpal Singh(ed.), *History and Culture of the Punjab, Part-ii, Punjabi University, Patiala, 1990.*
2. Fauja Singh (ed.), *History of Punjab, Vol, III Punjabi University, Patiala, 1987.*
3. J.S. Grewal, *The Sikhs of the Punjab, Cup, Cambridge, 1991.*
4. Khushwant Singh, *A History of the Sikhs, Vol. I, OUP, New Delhi, 1990*

FTL-173 Engineering Graphics and Drafting

Time : 3 Hours

Credits : 2-1-1

Max. Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

SECTION -A

Drawing Techniques : Various types of lines, principles of dimensioning, size and location of dimensions, symbols, conventions scales (plane and diagonal) and lettering as per IS Code SP-46 of practice for general engineering drawings. Practice of drawing various types of lines and dimensioning exercises. Drawing exercises pertaining to symbols, conventions.

Exercise on lettering techniques: Free hand printing and numerals in 3,5,8 and 12 mm sizes vertical and inclined at 75°; instrumental lettering in single stroke.

SECTION -B

Projection of Points, Lines and Planes : First angle and third angle projections, concept of horizontal and vertical planes, Projection of points and lines, True length, Horizontal and vertical traces, Projection of Planes, Traces of Planes, Auxiliary planes. Practice exercises on projection of points, lines and planes.

Projection and Sectioning of Solids : Projection of solids such as Prisms, Pyramids, Cylinders, Cones, Spheres, Auxiliary View. Principles of sectioning, types of sectioning, section lines, cutting plane lines. Practice on projection of solids. Practice on sectioning of solids by auxiliary planes.

Isometric Projection : Exercises on isometric views.

Orthographic Projections : Orthographic views, Missing views. Exercises on identification of missing views. Practice on orthographic projections.

SECTION -C

Practice of free hand sketching of different types of objects.

Intersection and Development of Surfaces): Intersection of cylinders, cones and Prisms, Axis of solids being vertical or horizontal. Development of surfaces of truncated cylinders, cones and prisms.

Exercises on intersection of solids - cylinder and cylinder, cylinder and cone, prism and prism, prism and cone, sphere with cylinder. Exercises involving development of surfaces (Y-Piece, Hopper, Tray and truncated pieces).

Fasteners: Introduction to temporary and permanent fasteners, rivetted and welded joints, types of screw threads, conventional symbols for internal and external threads. Exercises involving drawing of bolts, nuts, studs and locking devices.

SECTION -D

Symbols and Conventions : Symbols and conventions pertaining to relevant engineering disciplines. Practice in using Auto CAD or similar graphic package for preparing simple drawings.

Recommended Books:

1. Engineering Drawing by PS Gill, SK Kataria and Sons, Ludhiana.
2. Engineering Drawing by N.K. Bhatt.
3. Engineering and Teaching Drawing by Earl D. Black.
4. Text Book of Engineering Drawing by RK Dhawan, S. Chand and Company Ltd

FTP-121: EXPERIMENTS IN 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: EXPERIMENTS IN 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: EXPERIMENTS IN CHEMISTRY (PRACTICAL)

Credits: 0-0-2

1. Find the strength of 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 Ca^{2+} and 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 I_2 between 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.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-II)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

FTL-152: THERMAL SCIENCE

Time: 3 Hours

Credits: 3-1-0

Max. Marks: 100

Mid Semester Marks: 20

End Semester Marks: 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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

SECTION-A

Basic Concepts: Thermodynamic system, boundary and surroundings; open, closed and isolated systems. Energy and its forms: microscopic energy, macroscopic energy, internal energy, chemical energy and nuclear energy. Energy transfer across system boundaries; heat and work. State and equilibrium, process and cycle. Types of equilibrium. Pure substances and their phases. Zeroth Law, concept of thermal equilibrium and principle of thermometry. Types of thermometers: mercury-in-glass, bimetallic strip, resistance thermometer, infrared thermometer and thermocouple and electronic thermometer. Types of flow processes for an ideal gas under constant volume (Isochoric), constant pressure (isobaric), constant temperature (isothermal), adiabatic and polytropic conditions. Free expansion and throttling processes.

SECTION-B

First Law of Thermodynamics: Introduction to first law of thermodynamics, heat transfer, modes of heat transfer. Work and its forms. Internal energy, enthalpy and specific heat of ideal gases, solids and liquids. Applications of first law of thermodynamics for closed systems. Thermodynamic aspects of biological systems.

SECTION-C

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, their efficiencies. Reversible and irreversible processes. Carnot cycle, P-v diagram for Carnot cycle, Carnot Principles.

SECTION-D

Internal Combustion Engines: Piston cylinder arrangement, philosophy of spark- ignition cycle example Otto cycle, and compression-ignition cycle example Diesel combustion cycle; their compression ratio, power output and efficiency. Comparison between the two cycles.

Constructional and working details of two stroke and four stroke engines.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-II)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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

SECTION-A

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 carbohydrates.

SECTION-B

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.

SECTION-C

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, lipis billayers, monolayers and micelles, structure of cell membrane.

SECTION-D

Natural Pigments and Flavouring Agents: Chlorophyll, carotonoids, anthocyannics, 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, cyanocobalamine, folic acids. P – aminobenzoic acid, biotin, cholined.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-II)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

Recommended Books:

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

FTL-155: Applied Mathematics

Time: 3 Hours

Credits: 3-1-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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

SECTION-A

Differential Calculus: Partial derivatives, Euler's theorem for homogeneous functions, total derivative, change of variables, Lagrange's methods of undetermined multipliers.

SECTION-B

Exact differential equations, integrating factors, Linear differential equations, Cauchy's form, Legendre linear equations, simultaneous linear equations with constant coefficients, Total differential equations.

SECTION-C

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).

SECTION-D

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-II

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

Time: 3 Hours

Max. Marks: 50

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

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:

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

SECTION-A

Practical question on Note Making, Summarizing and Abstracting as given in *The Written Word* by Vandana R. Singh

SECTION-B

Practical question on Paragraph writing as prescribed in *The Written Word* by Vandana R. Singh

SECTION-C

Theoretical questions based on ABC of Good Notes as prescribed in *The Written Word* by Vandana R. Singh.

Section C from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

SECTION-D

Practical question on Essay writing from *The Written Word* by Vandana R. Singh
Section 4 from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition.

PBL 131 : ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ-II
(Compulsory)

ਸਮਾਂ : 3 ਘੰਟੇ

ਕਰੈਡਿਟ : 2
 ਕੁਲ ਅੰਕ : 50

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਸੈਕਸ਼ਨ-ਏ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 1-4 ਨਿਬੰਧ
 (ਨਿਬੰਧ ਦਾ ਸਾਰ, ਵਾਰਤਕ ਕਲਾ ਅਤੇ ਸ਼ੈਲੀ)
- II. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ : ਧਾਤੂ/ਮੂਲ, ਵਧੇਤਰ (ਅਗੇਤਰ, ਪਿਛੇਤਰ, ਵਿਉਂਤਪਤ ਅਤੇ ਰੁਪਾਂਤਰੀ), ਸਮਾਸ।

ਸੈਕਸ਼ਨ-ਬੀ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 5-8 ਨਿਬੰਧ
 (ਨਿਬੰਧ ਦਾ ਸਾਰ, ਵਾਰਤਕ ਕਲਾ ਅਤੇ ਸ਼ੈਲੀ)
- II. ਪੈਰ੍ਹਾ ਰਚਨਾ : ਕਲਾਸ ਵਿਚ 10 ਵਿਸ਼ਿਆਂ (ਸਭਿਆਚਾਰ, ਧਾਰਮਕ ਅਤੇ ਰਾਜਨੀਤਕ) 'ਤੇ ਪੈਰ੍ਹਾ ਰਚਨਾ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ।

ਸੈਕਸ਼ਨ-ਸੀ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 1-4 ਰੇਖਾ ਚਿਤਰ
 (ਨਾਇਕ ਬਿੰਬ, ਕਲਾਤਮਕ ਪੱਖ)
- II. ਮੁਹਾਵਰੇ ਤੇ ਅਖਾਣ (ਅਖਾਣ ਤੇ ਮੁਹਾਵਰਾ ਕੋਸ਼ ਵਿਚ) 200 ਮੁਹਾਵਰਿਆਂ ਅਤੇ 100 ਅਖਾਣਾਂ ਨੂੰ ਵਾਕਾਂ ਵਿਚ ਵਰਤਣ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ (ਕਲਾਸ ਵਿਚ ਤੇ ਘਰ ਲਈ)।

ਸੈਕਸ਼ਨ-ਡੀ

- I. **ਸਰਵੋਤਮ ਪੰਜਾਬੀ ਸਾਹਿਤ** (ਸੰਪਾ. ਡਾ. ਰਮਿੰਦਰ ਕੌਰ, ਡਾ. ਮੇਘਾ ਸਲਵਾਨ)
 5-8 ਰੇਖਾ ਚਿਤਰ
 (ਨਾਇਕ ਬਿੰਬ, ਕਲਾਤਮਕ ਪੱਖ)
- II. ਸ਼ਬਦ ਸ੍ਰੇਣੀਆਂ : ਨਾਂਵ, ਪੜਨਾਂਵ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ, ਸੰਬੰਧਕ

ਸਹਾਇਕ ਪੁਸਤਕਾਂ

1. ਸਤਿੰਦਰ ਸਿੰਘ, ਪੰਜਾਬੀ ਵਾਰਤਕ ਦਾ ਇਤਿਹਾਸ, ਪੰਜਾਬੀ ਅਕਾਦਮੀ, ਦਿੱਲੀ।
2. ਪ੍ਰੋ. ਪਿਆਰਾ ਸਿੰਘ, ਪੰਜਾਬੀ ਵਾਰਤਕ : ਸਿਧਾਂਤ ਇਤਿਹਾਸ ਪ੍ਰਵਿਰਤੀਆਂ, ਨਿਊ ਬੁੱਕ ਕੰਪਨੀ, ਜਲੰਧਰ।
3. ਇੰਦਰਪ੍ਰੀਤ ਸਿੰਘ ਧਾਮੀ, ਪੰਜਾਬੀ ਰੇਖਾ ਚਿੱਤਰ : ਰੂਪ ਤੇ ਪ੍ਰਕਾਰਜ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
4. ਬਲਬੀਰ ਸਿੰਘ ਦਿਲ, ਪੰਜਾਬੀ ਨਿਬੰਧ : ਸਰੂਪ, ਸਿਧਾਂਤ ਅਤੇ ਵਿਕਾਸ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
5. ਹਰਕੀਰਤ ਸਿੰਘ ਤੇ ਗਿਆਨੀ ਲਾਲ ਸਿੰਘ, ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਣ, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ, ਚੰਡੀਗੜ੍ਹ।
6. ਡਾ. ਅਮਰ ਕੋਮਲ (ਸੰਪਾ.), ਚੋਣਵੇਂ ਪੰਜਾਬੀ ਨਿਬੰਧ (ਭੂਮਿਕਾ), ਨੈਸ਼ਨਲ ਬੁੱਕ ਟਰੱਸਟ, ਇੰਡੀਆ।
7. ਅਬਨਾਸ ਕੌਰ, ਪੰਜਾਬੀ ਰੇਖਾ ਚਿੱਤਰ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ।
8. ਮਿੰਨੀ ਸਲਵਾਨ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਮੁੱਢਲੇ ਸੰਕਲਪ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।
9. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸਿਧਾਂਤ ਤੇ ਵਿਹਾਰ, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।

PBL-132 : ਮੁੱਢਲੀ ਪੰਜਾਬੀ
(Special paper in lieu of Punjabi Compulsory)

ਸਮਾਂ : 3 ਘੰਟੇ

ਕਰੈਡਿਟ : 2
 ਕੁਲ ਅੰਕ : 50

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

ਅੰਕ-ਵੰਡ ਅਤੇ ਪਰੀਖਿਅਕ ਲਈ ਹਦਾਇਤਾਂ

1. ਪ੍ਰਸ਼ਨ ਪੱਤਰ ਦੇ ਚਾਰ ਭਾਗ ਹੋਣਗੇ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਦੋ ਪ੍ਰਸ਼ਨ ਪੁੱਛੇ ਜਾਣਗੇ।
2. ਵਿਦਿਆਰਥੀ ਨੇ ਕੁੱਲ ਪੰਜ ਪ੍ਰਸ਼ਨ ਕਰਨੇ ਹਨ। ਹਰ ਭਾਗ ਵਿੱਚੋਂ ਇਕ ਪ੍ਰਸ਼ਨ ਲਾਜ਼ਮੀ ਹੈ। ਪੰਜਵਾਂ ਪ੍ਰਸ਼ਨ ਕਿਸੇ ਵੀ ਭਾਗ ਵਿੱਚੋਂ ਕੀਤਾ ਜਾ ਸਕਦਾ ਹੈ।
3. ਹਰੇਕ ਪ੍ਰਸ਼ਨ ਦੇ ਬਰਾਬਰ ਅੰਕ ਹਨ।
4. ਪੇਪਰ ਸੈੱਟ ਕਰਨ ਵਾਲਾ ਜੇਕਰ ਚਾਹੇ ਤਾਂ ਪ੍ਰਸ਼ਨਾਂ ਦੀ ਵੰਡ ਅੱਗੋਂ ਵੱਧ ਤੋਂ ਵੱਧ ਚਾਰ ਉਪ-ਪ੍ਰਸ਼ਨਾਂ ਵਿਚ ਕਰ ਸਕਦਾ ਹੈ।

ਸੈਕਸ਼ਨ-ਏ

ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ : ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ
 (ਨਾਂਵ, ਪੜਨਾਂਵ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ)

ਸੈਕਸ਼ਨ-ਬੀ

ਨਿੱਤ ਵਰਤੋਂ ਦੀ ਪੰਜਾਬੀ ਸ਼ਬਦਾਵਲੀ : ਬਾਜ਼ਾਰ, ਵਪਾਰ, ਰਿਸ਼ਤੇ-ਨਾਤੇ, ਖੇਤੀ ਅਤੇ
 ਹੋਰ ਧੰਦਿਆਂ ਨਾਲ ਸੰਬੰਧਤ

ਸੈਕਸ਼ਨ-ਸੀ

ਪੰਜਾਬੀ ਵਾਕ-ਬਣਤਰ
 ਸਾਧਾਰਨ ਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)
 ਸੰਯੁਕਤ ਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)
 ਮਿਸ਼ਰਤ ਵਾਕ (ਪਛਾਣ ਅਤੇ ਵਰਤੋਂ)

ਸੈਕਸ਼ਨ-ਡੀ

ਪੈਰ੍ਹਾ ਰਚਨਾ
 ਸੰਖੇਪ ਰਚਨਾ

ਸਹਾਇਕ ਪੁਸਤਕਾਂ

1. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ, ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਲੁਧਿਆਣਾ।
2. ਮੁੱਢਲੀ ਪੰਜਾਬੀ, ਕਸਤੂਰੀ ਲਾਲ ਐਂਡ ਸੰਨਜ਼, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ।
3. ਮਿੰਨੀ ਸਲਵਾਨ, ਪੰਜਾਬੀ ਵਿਆਕਰਨ : ਮੁੱਢਲੇ ਸੰਕਲਪ, ਰਵੀ ਸਾਹਿਤ ਪ੍ਰਕਾਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ।

HSL-102 : PUNJAB HISTORY & CULTURE (1717-1947)
(Special paper in lieu of Punjabi Compulsory)

Time : 3 Hrs.

Credits: 2-0-0

Marks : 50

Mid Semester Examination: 20% Weightage

End Semester Examination: 80% Weightage

Instructions for the Paper Setters

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

1. Sikh Struggle for Sovereignty.
2. Ranjit Singh : Conquests, Administration and the Anglo-Sikh Relations.

SECTION-B

3. Anglo-Sikh Wars and the Annexation.
4. The Punjab under the British: New Administration, Education and social Change.

SECTION-C

5. Economic Changes: Agricultural
6. Socio-Religious Reform Movements.

SECTION-D

7. Role of Punjab in the Freedom Struggle.
8. Fairs and Festivals.

Suggested Reading

1. Kirpal Singh (ed.), *History and Culture of the Punjab*, Part-II, Punjabi University, Patiala, 1990.
2. Fauja Singh (ed.), *History of Punjab*, Vol, III, Punjabi University, Patiala, 1987.
3. J.S. Grewal, *The Sikhs of the Punjab*, Cup, Cambridge, 1991.
4. Khushwant Singh, *A History of the Sikhs*, Vol. I, OUP, New Delhi, 1990

FTL-156: INDUSTRIAL MICROBIOLOGY

Credits : 3-0-0

Time: 3 Hours

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

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 kojie acids.

Section-C

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. Production of mushroom mycelium by submerged culture process. Production of algal protein and recent advances.

Section-D

Microbiological transformation of steroids. Production and isolation of antibacterial antibiotics like penicillin, streptomycin, septomycin, chloromycetin, 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.

FTP-172: EXPERIMENTS IN FOOD CHEMISTRY

Credits: 0-0-2
Max. Marks : 100

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.

FTP-176: EXPERIMENTS IN 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

FTL-201: BASIC FOOD ENGINEERING

Credits: 3-1-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks: 20
End Semester Marks: 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note: Students can use the Non-Programmable scientific calculator

Section -A

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: Extensive and intensive properties, density, concentration, moisture content, pressure, viscosity, equation of state and perfect gas law, phase diagram of water.

Section -B

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. Recycling and its uses, material balance problems with recycle.

Section -C

4. Energy balance: Principles of energy conversion and conservation, latent heat, and specific heat. Energy balance problems with and without material balance.

Section -D

5. Preservation processes: Microbial survivor curves, thermal death time, spoilage probability. General method for process calculations: applications to pasteurization, sterilization, aseptic processing and packaging.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-III)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

Microbiology and its scope.

Microscopy, classification.

Pure cultures and their characteristics.

Maintenance of cultures, culture techniques, enumeration techniques.

Section-B

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

Nutrition and reproduction, isolation and identification of micro organisms.

Microbial ecology.

Microbial interactions.

Section-C

Physical and chemical methods of control of micro organisms.

Virus, common pathogenic organisms, immune response.

Antigen - antibody interaction and antibodies.

Section-D

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

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

Good Manufacturing Practices. Good Laboratories Practices. Quality Circles and Quality Culture Concept

Section-C

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

Section-D

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. Mounthey 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

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

1. Juice extraction, maceration and imbibitions, mill sanitation. Color and coloured Nin-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.

Section-B

5. Syrup: Syrup brix and pH and their role in pan boiling, treatment/clarification of syrup.
6. Classien's theory of pan boiling. Concept or Masecuite boiling, different types of masecuite boiling i.e., 2M/C boiling, 3M/C boiling, 4 M/C boiling. Ideas of purities of different intermediate masecuite 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.

Section-C

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

Section-D

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.

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.

ECL-210: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Credits: 3-1-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

- 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.

Section-B

- 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
- 5. Induction motor:** Classification of A.C. Motors General Principle, construction, Relation between Torque and Slip, control of A.C. motors.

Section-C

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.
7. **Electronic Devices:** Semiconductors, Bipolar Junction Transistor., transistor circuit configuration transistor characteristics, Field Effect Transistor.

Section-D

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: EXPERIMENTS IN 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: EXPERIMENTS IN 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 SO₂ 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 3rd Edition published by John Wiley and Sons.
3. Handbook of Cane Sugar Technology, 2nd Edition, R.B.L. Mathur.

FTL-252: CEREALS AND PULSES TECHNOLOGY

Time: 3 Hours

Credits: 3-1-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

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 spaghett. Processing of wheat flakes.

Section-C

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.

Section-D

Pulses: Pulse Production and consumption trend, minor and major constituents, anti-nutritional factors. Criteria of pulse quality, Functional characterization of pulse flours, pulse starch isolation methods, characteristics of pulse starch and digestibility production methods of protein isolates, protein concentrates, functional properties of protein isolates and concentrates, pulse products (canned, germinated, extruded), Indigenous pulse products (papad, wari, dosa).

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

Time: 3 Hours

Credits: 3-1-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

Fruit Life Cycle , Respiration pattern of Fruits & Vegetables, Role of ethylene, Prepackaging of fresh fruits and vegetables. Storage techniques for fresh fruits and vegetables. Processing of fruit juices.

Section-B

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

Section-C

Preparation of preserve and candied fruits. Pickling of fruits and vegetables. Preparation of wine. Canning of fruits and vegetables.

Section-D

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-255: FLUID FLOW AND HEAT TRANSFER

Credits: 3-1-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks: 20
End Semester Marks: 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note: Students can use the Non-Programmable scientific calculator

Section-A

Nature and classification of fluids. Concept of viscosity and its measurement – capillary tube viscometer, rotational viscometer. Mechanical energy balance, Bernoulli's equation and its applications. Friction in pipes and pipe fittings.

Section-B

Pumps and their classification. Centrifugal pumps: volute type and diffuser type. Positive displacement pumps: piston pump, diaphragm pump, helical screw pump, gear pump, lobe pump and peristaltic pump. Flow measurement devices - Pitot tube, Orifice tube, Venturimeter. Pressure and its measurement - Simple and Differential manometers.

Section-C

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.

Section-D

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.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-IV)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

Recommended Books:

1. Introduction to Food Engineering (3rd Edition) by R Paul Singh and Dennis R Heldmann; Academic Press, London, UK, 1993.
2. Unit Operations of Chemical Engineering (5th 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 Kumar Jain; Himanshu Publications, Udaipur, 2002.
4. Heat Transfer (7th Edition) by J P Holman; McGraw-Hill, Inc., New Delhi, 2008.
5. Transport Processes and Unit Operations (3rd Edition) by Christie J Geankoplis, Prentice-Hall of India Pvt Ltd, New Delhi, 1999.

FTL-258: SUGAR INDUSTRY CO- PRODUCTS

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

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 CO₂ 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.

Section-C

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

Section-D

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-IIInd Edition), Elsevier Publishing Co.

FTL-256: MECHANICAL OPERATIONS

Time: 3 Hours

Credits: 3-1-0

Max. Marks: 100

Mid Semester Marks: 20

End Semester Marks: 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note: Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

2. Filtration

Theory of filtration, filtration equations for constant pressure and constant rate filtration, filtration equipment: bed filters, plate-and-frame filter presses, leaf filters and continuous rotary filters. Filter media and filter aids.

Section-C

3. Sedimentation

Theory, free and hindered settling, sedimentation equipment: simple gravity settling tank, simple gravity settling classifier, Spitzkasten classifier and sedimentation thickener.

4. Centrifugal Separation

Theory, basic equation, rate of separation, liquid separation, gas-solid separation, centrifugation equipment: tubular centrifuge and disc bowl centrifuge.

Section-D

5. 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.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-IV)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

Recommended Books:

1. Transport Processes and Unit Operations (3rd Edition) by Christie J Geankoplis, Prentice- Hall of India Pvt Ltd, New Delhi, 1999.
2. Food Engineering Operations (3rd 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 (5th Edition) by Warren L McCabe, Julian C Smith, Peter Harriott; McGraw-Hill, Inc., New Delhi, 1998.
4. Unit Operations in Food Processing (2nd 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.

FTP-271: EXPERIMENTS IN 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: EXPERIMENTS IN 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-274: EXPERIMENTS IN 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.

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-IV)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

**FTP- 276: EXPERIMENTS IN SUGAR INDUSTRY CO PRODUCTS
(LAB)**

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

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-V)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

FTL-301: DAIRY TECHNOLOGY

Credits: 3-1-0

Time: 3 Hours

Max. Marks: 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

5. Synthetic milk and its detection.
6. Various analytical techniques of determination of milk quality.
7. Chemistry and technology of cream, butter, margarine and ghee manufacture
8. Production of ice cream and other frozen desserts.

Section-C

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).
11. Technology of cheese and other fermented milk products.

Section-D

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

Time : 3 Hours

Credits : 3-1-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section- A

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. Communitated meat products.

Section-B

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.

Section C

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.

Section-D

Fish structure and composition. Cold storage, Fish preservation. Freezing and smoking. Canning of fish. Picking of fish, Fish protein concentrates, Fish meal. Fish oil and other by products of fish processing industry.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-V)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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.

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-V)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

FTL-303: FATS AND OIL TECHNOLOGY

Time : 3 Hours

Credits : 3-1-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

Introduction to Fats & Oils , Common chemical reactions of Fats & Oil, Nutritional properties of edible fats and oil , Non glyceride components of oils & fats, Status of oils and fats and Indian Economy, General chemistry, Analytical methods for characterization.

Section-B

Physical and chemical properties of fats & oil, Antioxidants, Rancidity and Reversion, oil and fats in diet, nutrition and disease. Hydrogenation, Fractionation and winterization of edible fats, Extraction and clarification of vegetable oil.

Section-C

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, Use of edible oils and fats in foods

Section-D

Quality standards of edible oils and fats. Detection of adulteration. Technology of oilseed protein isolate, Packaging of edible oils, by product utilization from oil industries.

Recommended Books:

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

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-V)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

FTL-306: MASS TRANSFER

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks: 20

End Semester Marks: 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note: Students can use the Non-Programmable scientific calculator

Section-A

Molecular diffusion: Theory of diffusion: Fick's law. Types of diffusion: steady state and unsteady state. Concept of diffusivity. Measurement of fluxes. –Molecular diffusion in liquids and gases. Steady state equimolar counter diffusion, and special case for a diffusing gas through non-diffusing gas.

Convective mass transfer coefficients and mass transfer theories.

Analogies between heat, mass and momentum transfer.

Applications of diffusion in food engineering unit operations.

Section-B

Crystallization: Theory of crystallisation, material and energy balance calculations, methods of crystallization. Crystallizer types: tank crystallizer, scraped-surface crystallizer, circulating-liquid evaporator-crystallizer and circulating-magma vacuum crystallizer.

Section-C

Distillation: Vapor-liquid equilibria, relative volatility. Introduction to distillation methods. Types of distillation: flash or equilibrium distillation, simple batch or differential distillation, steam distillation, azeotropic and extractive distillation,. Theory of rectification column design.

Section-D

Extraction: Fundamental principles of liquid-liquid extraction, selectivity, and choice of solvent. Material balances and process flow charts for single stage and multi-stage extractions.

Equipment for liquid-liquid extraction: separate mixer settler, combined mixer settler and spray extraction towers.

Fundamental principles of solid-liquid extraction (leaching). Leaching process for biological and inorganic substances. Leaching process and determination of rates of leaching. Material balance calculations. Types of leaching equipment: fixed bed leaching, moving bed leaching and agitated solid leaching.

Recommended Books:

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

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-V)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

FTL-307: COMPUTER APPLICATIONS IN FOOD INDUSTRY

Time : 3 Hours

Credits : 3-1-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

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)

Section-C

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)

Section-D

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: EXPERIMENTS IN 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 by MBRT and Resazurin test.
7. Preparation of sterilized flavored milk.
8. Preparation of
 - a) Butter
 - b) Ghee
 - c) Ice Cream
 - d) Paneer and Chhana
 - e) Milk Powder
 - f) Khoa
9. Visit to milk processing plant.

FTP-322: EXPERIMENTS IN 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: EXPERIMENTS IN 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: EXPERIMENTS IN 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. Familiarization 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 familiarization 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(), strlwr(),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.

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

FTL-351: FOOD REGULATIONS AND QUALITY CONTROL

Time : 3 Hours

Credits : 3-1-0

Max. Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

Introduction, Objective and importance of general principles of quality control, Quality attributes - color, gloss, viscosity and consistency, size and shape and texture. Texture characteristics of different foods and their evolution.

Section-B

Flavor and Taste. Introduction to sensory evaluation of foods. Different sensory evaluation techniques. Good Manufacturing Practices, Good Laboratory Practices.

Section-C

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, Introduction to ISO Series.

Section -D

Foods Laws and Regulations-Food Safety and Standards Act,2006, MOFPI, Agricultural Product Act 1937 (AGMARK); APEDA, MOFPI Bureau in Indian Standards (Certification Marks) Act, 1952. The consumers' Protection Act, 1986. 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.
4. Textural Characteristics of world foods edited by Katsu Yoshi Nishinari, 2020.

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

FTL-352: APPLICATIONS OF ENZYMES IN FOOD INDUSTRY

Time : 3 Hours

Credits : 3-0-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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

Section-B

4. Sources of enzymes and their production.
5. Significance of enzymes in starch industry- high fructose corn syrups, glucose syrups, monohydrate dextrose.

Section-C

6. Role of enzymes in meat tenderization
7. Application of amylases, proteases, lipoxidase, lipases and pentosanes in baking industry.

Section-D

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 Book:

Food Enzymes by Reed.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

FTL-353: BIOCHEMICAL ENGINEERING

Time: 3 Hours

Credits: 3-0-0

Max. Marks: 100

Mid Semester Marks: 20

End Semester Marks: 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note: Students can use the Non-Programmable scientific calculator

Section-A

1. Introduction: Introduction to biochemical engineering, chemical engineering, microbiology, biotechnology and biochemistry.
2. Cell growth: Introduction: chemical composition, nutritional requirements, metabolism and classification based on nutritional requirements, quantifying cell concentration: cell number density methods and cell mass concentration methods (both direct and indirect), growth patterns and kinetics in batch culture, effect of environmental conditions on growth kinetics, heat generation by microbial growth.

Section-B

3. Enzymes: Terms used in enzymology, theory of enzyme catalysis, enzyme immobilization techniques, properties of immobilized enzymes, industrial applications: food and beverages and diagnostic biosensors.

Section-C

4. Enzyme kinetics: Introduction: kinetics of microbial growth, limiting substrate, mechanistic models for simple enzyme kinetics: Monod model, Modified-Monod model, Tiessier's equation, Michaelis-Menten type kinetics with rapid equilibrium approach and quasi steady state assumption.

Section-D

5. Fermenter design, control and scale up: Introduction to different fermentation processes and fermenters, design considerations, body construction, monitoring and controlling parts, inoculation and sampling, scale up considerations.
6. Continuous fermentation.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

FTL-354: PACKAGING TECHNOLOGY

Time : 3 Hours

Credits : 3-1-0
Max.Marks : 100
Mid Semester Marks : 20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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

Section-B

5. Use of Plastic, metal and glass in food packaging
6. Laminates and coextruded films.
7. Special packaging methods: Retortable packaging, Aseptic, vacuum, shrink packaging.

Section-C

8. Free oxygen scavenging packaging.
9. Modified and controlled atmosphere packaging.
10. Shelf life prediction.
11. Edible films and coatings

Section-D

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.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

FTL –357: HUMAN RESOURCES MANAGEMENT IN FOOD INDUSTRY

Time : 3 Hours

Credits : 3-0-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

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.

Section-B

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. Motivation theories, Communication in organization.

Section-C

Quality of Working life. Performance Appraisal, Grievances and Grievance Handling Procedure, Discipline and Disciplinary action. Team Building Human Relations and Industrial Relations. Differences between Human Relation and Industrial Relations. Factors required for good human relations policy in industry.

Section-D

Employee-Employer relationship, Causes and effects of Industrial disputes; Prevention and statement 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.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

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

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VI)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

FTL-358: SUGAR INDUSTRY (TECHNICAL CONTROL AND DESIGN)

Time : 3 Hours

Credits : 3-1-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

Section-A

MILLING CONTROL: Technical definitions, fundamental formula for cane, added water, mixed juice and bagasse, calculation of brix percent bagasse, fibre percent bagasse, undiluted juice lost in bagasse percent fibre, added water in mixed juice percent added water in cane. Methods of control-differential and inferential methods, primary extraction, secondary extraction using simple and compound imbibition scheme. Ideal extraction, mill extraction, brix curves, brix free cane water, lost juice percent fibre, reduced mill extraction, E.R.Q.V., Inferential methods for calculation, undiluted juice percent cane, undiluted juice in mixed juice percent cane, added water percent cane and added water per unit cane, indirect method of calculating cane weight. Methods of comparison of milling efficiency of factories.

Section-B

BOILING HOUSE CONTROL: S.J.M.formula and its postulates, winter Carp's formulas, relation between S.J.M. and winter's formulas. Differences between commercial sugar, standard granulated and equivalent standard Granulated (E.S.G.), calculation of E.S.G., clarification factor, actual molasses percent theoretical molasses and non-sugar in molasses percent non-sugar in mixed juice. boiling house recovery, basic boiling house recovery, boiling house performance and boiling house recovery (E.S.G.) Comparison of boiling house recovery of different factories, virtual purity of waste molasses, reduced boiling house, recovery. Norms of efficiency

Section-C

CAPACITY Selection of site, types of plant i.e. gravity & non-gravity. Cane Carrier, Cane knives. Mill capacity, Power requirement for milling tandem. mill screen area, juice pumps, imbibition water pump, mixed juice / water weighing scale, juice receiving tanks, M.J. Pump. Juice heaters, Sulphur furnace -combustion temp. % of SO₂, tray area, milk of lime preparation tanks & pumps. continuous juice sulphiter. clarifiers. rotary vacuum filters. Evaporators, Condensers. Capacity of injection pump. Spray pond -depth, area, spray pumps, spray nozzles, forced draught cooling towers.

Section-D

Capacity of syrup sulphiter, syrup pumps. Capacity of pans, crystallizers, cooling time for different massecuites, vertical crystallizers, brief idea about its design. Centrifugal -batch type & continuous centrifugal machines, nos. of machines required for a sugar factory, sugar conveyers, elevators, graders. Storage of sugar & molasses, N.C.V. & G.C.V. of bagasse, calculation of steam balance, calculation of heating surface of boilers.

Recommended Books:

1. Cane Sugar Handbook: Chen & Meade.
2. Standard Fabrication Practice for Cane Sugar Mills Deldan.
3. Handbook of Cane Sugar Engineering. E. Hugot.
4. Machinery & Equipment of Cane Sugar Factory: L.A. Tromp.
5. Handbook of Cane Sugar Tech.: R.B.L. Mathur.
6. System of Technology Control for Cane Sugar Factories in India, 1st edition, N.C.Varma.

FTP-371: EXPERIMENTS IN 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: **EXPERIMENTS IN 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. Measurement of mass transfer coefficient ($K_L a$) by dynamic method..
4. Determination of total dissolved solids in water.
5. To study the working of effluent treatment plant.
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. Visit to food industry.

FTP-373: EXPERIMENTS IN 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. Pre-Packaging of 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.
14. Determination of thermal shock resistance of glass containers.

FTP: 374 EXPERIMENTS IN SUGAR INDUSTRY DESIGN LAB.

CREDITS: 0-0-2

1. **Juice Heaters:** To find out the heating surface area, number of tubes, dia, thickness of heaters, shell thickness with respect to hydraulic test pressures.
2. **Evaporator:** With a given heating surface area, to find out the number of tubes, downtake dia, tube plate design, dimension, vapour body thickness under external pressure (Vacuum conditions and calendria design).
3. **Pans:** With given capacities to find the heating surface, down take dimension, shell dimensions with standard tubes, tube plate thickness with heat exchange principle.
4. **Storages Vessels:** Molasses tank for different crushing capacities, so find the thickness of various courses of steel tank, dia and height of steel tank.
5. **Rollers:** Taking into consideration then hydraulic load and bearing journal pressures.
6. **Crystallizers:** To find the dimension paramotor of crystallizers taking considerations of the volume of massecuites discharged into crystallizers, cooling temp. at different time intervals.
7. **Condenser:** Design the multi jet condenser, calculate the height of the condenser, cross-section of the condenser, condenser volume size of vapour pipe, diameter of cooling water piper, wt. of cooling water required.
8. **Juice sulphiter :** Design, Dia and height, juice pipe entry, SO₂ gas pipeline dia, Milk of line pipe line dia. Required.
9. **Plant layout:** layout of the factory, lay out of the machinery, precautions to be considered.
10. **Visit to sugar complex**

Books Recommended

1. Hand book of Sugar Engineering by E.Hugot
2. Engineering Drawing by P.S.Gill

FTL-401: FOOD PROCESS ENGINEERING

Time : 3 Hours

Credits : 3-1-0
Max.Marks : 100
Mid Semester Marks :20
End Semester Marks : 80

Mid Semester Examination: 20% weightage
End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

SECTION A

1. Refrigeration

Selection of refrigerant, components of refrigeration systems - different types of evaporators, compressors, condensers, expansion valves; pressure-enthalpy chart for a vapour-compression refrigeration cycle under saturated conditions, pressure-enthalpy chart for a vapour-compression refrigeration cycle with deviations; and mathematical expressions useful in the analysis of vapour compression refrigeration.

SECTION B

2. Freezing

Different types of food freezing systems - indirect contact systems: plate freezer, air-blast freezer and freezers for liquid foods; and direct contact systems: air blast freezing system and immersion freezing system; freezing time calculations using Plank's equation.

SECTION C

3. Evaporation

Boiling point elevation, types of evaporators – batch-type pan evaporator, natural circulation evaporator, rising-film evaporator, falling-film evaporator, rising/falling-film evaporator, forced-circulation-type evaporator, agitated thin-film evaporator; design of single effect and multi effect evaporators, steam economy, vapour recompression systems – thermal recompression and mechanical recompression.

**B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VII)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024**

4. Extrusion

Functions of extrusion, advantages of extrusion, development of extruders, extrusion terminology – feedstock, preconditioner, screw, shear, interrupted- or cut-flight screw, barrel, cooling/heating jacket, vent, barrel section, barrel liner, length-to-diameter ratio, compression ratio, die plate, pellet, collet, die land, cutter; types of extruders, classification of single screw extruder: based on extent of shear – cold forming extruders, high-pressure forming extruders, low-shear cooking extruders, collet extruders, high shear cooking extruders; based on heat generation – adiabatic extruders, isothermal extruders, polytropic extruders; based on design – solid single-screw extruders, interrupted-flight extruder-expander, single segmented-screw extruders; twin screw extruders and their classification.

SECTION D

5. Drying

Theory of drying, bound moisture, free moisture, water activity, equilibrium moisture content, hygroscopic material, non-hygroscopic material, case hardening, drying rate curves - constant rate drying period, critical moisture content and falling rate drying period. Representation of moisture content on wet basis and dry basis and their relationship. Engineering aspects of different types of driers including bin drier, cabinet or tray drier, belt or conveyor drier, fluidized bed drier, kiln drier, pneumatic drier, spray drier, trough drier, tunnel drier and freeze drier.

Recommended Books:

1. Introduction to Food Engineering (3rd Edition) by R. Paul Singh and Dennis R. Heldman, Academic Press, Inc.
2. Unit Operations of Chemical Engineering (5th Edition) by Warren L. McCabe, Julian C. Smith, Peter Harriott, McGraw-Hill, Inc., New Delhi.
3. Transport Processes and Unit Operations (3rd 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

Time : 3 Hours

Credits : 3-1-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

SECTION -A

Crystalline and non crystalline sugar confectionary: fondant, hard boiled candy, caramel, toffee, fudge, nut brittles, krokant, praline, truffles, pulled sugar, marshmallows. Basic ingredients: sucrose, glucose syrup, invert syrup, sugar alcohols

SECTION -B

Gums and jellies, pastilles, turkish delight, marzipan. Sugar panning. Defects in confectionary: sugar bloom. Chewing gum and bubble gum: manufacturing and ingredients. Packaging requirements of sugar confectionary.

SECTION -C

Chocolate confectionary: Processing of cocoa beans: harvesting, fermentation, roasting, grinding. Chocolate refining, conching,

SECTION -D

Tempering, molding, enrobing, panning. Ingredients used in chocolate. Cocoa butter equivalents and 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

Time : 3 Hours

Credits : 3-0-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

SECTION -A

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

SECTION -B

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

SECTION -C

Flavour Technology - Physiology of flavor. Classification of flavouring compounds. Production of compound flavouring. Standards for compound flavourings. Instrumental and sensory analysis of flavourings.

SECTION -D

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.

B.TECH. FOOD SCIENCE & TECHNOLOGY (4 YEARS) (CBEGS) (SEMESTER-VII)
SYLLABUS FOR THE BATCH FROM THE YEAR 2020 TO YEAR 2024

FTL-404: FOOD PROCESSING PLANT LAYOUT AND DESIGN

Time : 3 Hours

Credits : 3-0-0

Max.Marks : 100

Mid Semester Marks : 20

End Semester Marks : 80

Mid Semester Examination: 20% weightage

End Semester Examination: 80% weightage

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Note : Students can use the Non-Programmable scientific calculator

SECTION A

Plant Location

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

Plant Layout

Plant layout – objectives and principles; types of layouts – process layout, product layout, combination layout, fixed position layout; flow patterns; workstation design; methods of plant and factory layouts; plant layout procedure.

SECTION B

Factory Building

Building design considerations – flexibility, expandability, service and employee facilities, lighting, heating, ventilation, air-conditioning, etc.

Network Analysis of Processes

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

SECTION C

Cost Analysis

Introduction to cost and accounting; elements of cost – material, labour and expense; nature of cost – fixed, variable, semi-variable, controllable, uncontrollable. Depreciation – definition and concept, causes of depreciation, methods of calculating depreciation – straight line method, reducing balance method, production based method, rapid provision method, annuity method, sinking fund method.

SECTION D

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: EXPERIMENTS IN 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: EXPERIMENTS IN 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: EXPERIMENTS IN 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: 0-0-16

Students will be required to undertake Practical Training in Industrial establishment in the 8th 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 containing a copy of original certificate. 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 make PowerPoint presentation of industrial training and will be orally examined in the context of the training report.

FTP-452 : RESEARCH PROJECT

Credits : 0-0-4

Every student will be required to submit a project report or equipment design report in typed standard form on a topic set by one or more teachers. The objective of the Project Work is to test the ability of the student to tackle an investigational problem in his field of specialization. Every student will be orally examined in the subject incorporated in his Project Report.