West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Food Processing Technology
[FPT]

Part-III (6th Semester)

2023

PROPOSED DETAILS SYLLABUS FOR THE PART - III (3RD YEARS, 6TH SEMESTER) OF THE FULL TIME DIPLOMA COURSE IN FOOD PROCESSING TECHNOLOGY

WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT

TEACHING & EXAMINATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES

COURSE NAME: FOOD PROCESSING TECHNOLOGY

COURSE CODE: FPT

SEMESTER: SIXTH

DURATION OF COURSE: 6 SEMESTERS

Sl. No.	Category of Course	Code No	Course Title	Hours Per Week		Total Contact Hours Per Week	Credit	Full Marks	Internal	ESE
				L	P					
1	Program Core Course	FPTPC 302	Food Packaging and Labeling	2	0	2	2	100	40	60
2	Program Core Course	FPTPC 304	Food Industry Waste Management	2	0	2	2	100	40	60
3	Program Elective Course	FPTPE 302	**Program Elective-IV** **1)** Food Plant Design and Layout **2)** Food Plant Maintenance and Hygiene **3)** Food Metabolism and Nutrition **4)** Tea processing and Brewing Technology	2	0	2	2	100	40	60
4	Humanities and Social Science	HS302	Entrepreneurship and Start-ups	3	0	3	3	100	40	60
5	Open Elective Course	FPTOE 302	**Open Elective I** Engineering Economics and Project Management	3	0	3	3	100	40	60
6	Open Elective Course	FPTOE 304	**Open Elective II** **1)** Environmental Science and Engineering **2)** Industrial Management **3)** Sustainable Development **4)** Renewable Energy	3	0	3	3	100	40	60
Sessional										
7	Program Core Course	FPTPC 306	Food Industry Waste Management Lab.	0	3	3	1.5	100	60	40
8	Major Project	FPTPR 302	Major Project-II	0	3	3	1.5	100	60	40
9	Seminar	FPTSE 302	Seminar	0	2	2	1	100	60	40
TOTAL				**15**	**08**	**23**	**19***	**900**	**420**	**480**

STUDENT CONTACT HOURS PER WEEK: 23 hours (Lecture-15 hours; Practical-08 hours)
Theory and Practical Period of 60 minutes each.
FULL MARKS-900 (Internal Marks= 420; ESE Marks = 480)
L-Lecture, P-Practical, ESE- End Semester Examination
Two Elective Subjects have to be Selected from List of Program Elective -IV and Open Elective -II
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately in each subject.

WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Food Processing Technology	
Category: Program Core	**Semester: Sixth**
Code No.: FPTPC 302	**Theory: 100 Marks**
Course Title: Food Packaging and Labeling	**Examination Scheme:** External Assessment: **60 Marks** (End Semester Examination) Internal Assessment:**40 Marks** [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration: 17 weeks (Total hours per week = 2)	
Total lecture class/week: 2 hours	
Credit: 2	
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective:

To provide basic knowledge of packaging, its types and components, package developments.
To provide knowledge of different types of packaging materials & their forms used in food packaging.
To provide knowledge of package developments and packaging laws and regulations in food industries.
To provide knowledge about package performance and various testing of packaging materials.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Introduction to Food Packaging**	1.1 Definition and basic functions of packaging; Different forms of packaging - Rigid, semirigid and flexible, Primary, secondary and tertiary; Primary Packaging Materials (Paper and paper based packaging materials, Plastic as packaging materials); Secondary Packaging Material (Folding carton); Transport packaging materials (corrugated fiber board boxes, wooden boxes). 1.2 Ancillary Packaging Materials (Printing inks, varnishes, lacquers and adhesives); Glass packaging materials (Composition, properties), Aluminium foil, Metal packaging materials. (Manufacture of tin plate, TFS, fabrication, corrosion and remedial measures). 1.3 Different types of packaging materials used – Polymer, paper, metal, glass – Fundamental properties (Barrier, mechanical, thermal and optical), merits and demerits and uses. 1.4 Cellulosic and Polymeric packaging materials and forms: Food grade polymeric packaging materials, Rigid plastic packages. Films: Multilayer films, Oriented, Co-extruded films, Laminates and Metalized 1.5 Polymeric materials, their mechanical sealing and barrier properties: Cellophane, Olefins, Polyamides, Polyesters, PVC, PVDC, PVA, Inomers, Copolymers, Polycarbonates, Phenoxy, Acrylic and Polyurethane.	**06**

Unit 2	**Special Packaging Materials and Packaging Equipments**	2.1 Laminates, metalized films, composite material, biodegradable material (biocomposites); Manufacturing of paper as packaging material (Schematic diagram). 2.2 Glass containers: Composition, Properties, manufacturing of glass bottles container (Schematic diagram), Bottle making and Closures for glass containers. 2.3 Metal containers: Manufacturing of Bulk containers, Tin-plate containers, Tin free steel containers, Aluminum containers, manufacturing of metal cans (Schematic diagram). 2.4 Packaging equipments – Form-fill-seal machine (Horizontal and vertical), Filling equipments, Sealing machine. Bottle filling machine, capping machine, labelling equipments, strapping, cartooning machineries. 2.5 Green plastics for food packaging (Problems of plastic packaging wastes, range of biopolymers, developing biodegradable plastic materials, bio composite)	**06**
Unit 3	**Food Packaging Interactions**	3.1 Selection of packaging materials and formats for different food sectors – Dehydrated foods, Frozen foods, Dairy products, bakery and confectionary products, cereal and pulses, Edible oils and Fats, ground and whole spices, Fresh fruits, Vegetables, Meat, fish, Poultry, Sea foods, Dry premixes, Instant foods, extruded foods, snack foods, alcoholic and non-alcoholic beverage, carbonated beverages, fruits and vegetable products.	**04**
Unit-4	**Different Methods of Packaging**	4.1 Vacuum packaging, Modified and control atmosphere packaging, shrink packaging, aseptic packaging. 4.2 Advanced packaging techniques (nanopackaging, active and intelligent packaging), Active Packaging Techniques and intelligent Packaging Techniques, 4.3 Oxygen, ethylene and other scavengers (Oxygen scavenging technology, selecting right types of oxygen scavenger, ethylene scavenging technology, carbon dioxide and other scavengers), 4.4 Antimicrobial food packaging (Antimicrobial agents, constructing antimicrobial packaging systems, factors affecting the effectiveness of antimicrobial packaging), 4.5 Non-migratory bioactive polymers (NMBP) in food packaging (Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds and their applications).	**05**
Unit 5	**Testing and Regulation of Packaging Materials**	5.1 Package Evaluation: evaluation of mechanical, optical and barrier properties like WVTR, GTR, bursting strength, tensile strength, tearing strength, drop test. 5.2 Time Temperature indicators (Defining and classifying TTIs, Requirements for TTIs, development of TTIs, Maximizing the effectiveness of TTIs, Using TTIs to monitor shelf life during distribution). 5.3 The use of freshness indicator in packaging (Compounds indicating the quality of packaged food products, freshness indicators, pathogen indicators, other methods for spoilage detection). 5.4 Packaging-flavour interaction (Factors affecting flavour absorpstion, role of food matrix, role of differing packaging	**05**

		materials, flavour modification and sensory quality). 5.5 Moisture regulation (Silica gel, clay, molecular sieve, humectants, salts, irreversible adsorption) 5.6 Packaging regulations as per FSSAI, The Standards of Weights and Measures Act, 1976 and the Standards of Weights and Measures (Packaged Commodities) Rules, 1977 (SWMA).The Prevention of Food Adulteration Act, 1954 and the Prevention of Food Adulteration Rules, 1955 and its first amendment, 2003 (PFA).The Fruit Products Order, 1955 (FPO), The Meat Food Products Order, 1973 (MFPO), The Edible Oil Packaging Order, 1998, The Agmark Rules, The Solvent Extraction Oil. Deoiled Meat and Edible Flour (control) Order 1967, The Milk & Milk Products Order 1992, Infant milk substitute, Feeding Bottles and Infant Foods Act 1992.	
Unit 6	**Labeling, Storage, Transport and Distribution of Packaging Materials**	6.1 Printing on packaging material, barcodes, RFID, QR codes, Labelling, Objective of labeling, Three Kinds of Labels-rand Label, Description Label, Grade Label, Declarations on Labelling, Contents in a food label, food safety and standards (packaging and labeling) regulations, 2011. 6.2 Environment and cost considerations of packaging materials –transport of packaging material to industry, transport of packaged foods. Storage and shelf-life study of packaged foods. 6.3 Integrating intelligent packaging, storage and distribution (supply chain for perishable foods, role of packaging in the supply chain, creating integrated packaging, storage and distribution).	**04**
Sub Total: Total Lecture Classes			**30**
No. of classes required for conducting Internal Assessment examination			**04**
Grand Total:			**34**

Course Outcome: The students of the course should be able to

CO1: Define fundamentals of packaging technology and packaging materials.
CO2: Interpret different processes related to manufacturing of packaging material, methods of packaging, packaging technique and equipments.
CO3: Explain interaction between package-flavour, gas storage systems for food storage, scavengers and emitters for improving the food quality and use of various indicators for checking the quality of packaged food products.
CO4: Outline Labeling, storage, transport and distribution of Packaging materials
CO5: Identify suitable packaging materials by test-analysis and through legal specifications.

3. Suggested Home Assignment/Student Activities: (At least Two assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher.

Sl. No.	Topics for Home Assignment	Marks
1.	Explain Function of Rigid, semirigid and flexible, Primary, secondary and tertiary; Primary Packaging Materials.	5
2.	Explain Function of Ancillary Packaging Materials (Printing inks, varnishes, lacquers and adhesives).	5
3.	Classify Polymeric types of packaging materials.	5
4.	Illustrate Fundamental properties (Barrier, mechanical, thermal and optical) of Polymer, paper, metal, glass.	5
5.	Illustrate working principle of Form-fill-seal machine (Horizontal and vertical).	5
6.	Explain the method of manufacturing of glass bottles and container.	5
7.	Explain the method of manufacturing metal cans.	5
8.	Explain basic principle of Modified and control atmosphere packaging.	5
9.	Explain basic principle of aseptic packaging.	5
10.	Explain basic principle of intelligent Packaging Techniques.	5
11.	Explain basic principle of Oxygen, ethylene and other scavenging technology.	5
12.	Explain basic principle of antimicrobial food packaging technology.	5
13.	Explain basic principle of Non-migratory bioactive polymers (NMBP) technology in food packaging.	5
14.	Evaluate mechanical, optical and barrier properties of packaging materials.	5
15.	Outline system of Time Temperature indicators for monitor shelf life of packed food during distribution.	5
16.	Outline system of freshness indicator for monitor shelf life of packed food during distribution.	5
17.	Illustrate Packaging-flavour interaction for different types of packaging materials	5
18.	Illustrate Packaging rules and regulations.	5
19.	Explain need of barcodes, RFID, QR codes Printing on packaging material.	5
20.	Explain Objective and function of labeling on packaging materials.	5
21.	Illustrate role of packaging in the supply chain.	5
22.	Interpret Green plastics for food packaging.	5

4. Suggested scheme for question paper design for conducting internal assessment (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. Suggested Learning Resources:

i) Gordon L. Robertson, Food Packaging: Principles and Practice, Third Edition,2013.
ii) Gordon L. Robertson, Food Packaging and Shelf Life: A Practical Guide,2010.
iii) Ruben Hernandez, Susan E. MSelke, John Culter, John D. Culter, Plastics Packaging: Properties,Processing, Applications, and Regulations,2000.
iv) Walter Soroka, Fundamentals of Packaging Technology-Fourth Edition.
v) M. Mahadeviah and R.V. Gowramma, " Food Packaging Materials", Tata. Mc Graw Hill co. Ltd. New Delhi.
vi) Stanley Sacharow and R.C. Griffin, "Principles of Food Packaging" , AVI Publishing Company.
vii) Coles R., McDowell D. and Kirwan, M.J.," Food Packaging Technology", Blackwell Publishing Co.
viii) Principal of Food Packaging by Sacharow & Griffin, Van Nastrand Rainhold Company, New York.
ix) Food Packaging Materials by Mahadeviah & Growramma
x) A Handbook of Food Packaging by Frank A. Paine
xi) Food Packaging Materials by N.T.Crosby
xii) Canning and Aseptic Packaging by Ranganna, TMH.
xiii) Food Packaging: Priciples and Practices by Gordon L.Robertson.
xiv) Food Science and Processing Technology Vol. II by Mridula Mirajkar and Sreelata Menon.

Name of the Course: Diploma in Food Processing Technology	
Category: Program Core	**Semester: Sixth**
Code No.: FPTPC304	**Theory: 100 Marks**
Course Title: Food Industry Waste Management	**Examination Scheme:** i) External Assessment: **60 Marks** (End Semester Examination) ii) Internal Assessment: **40 Marks** [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration: 17 weeks (Total hours per week = 2)	
Total lecture class/week: 2 hours	
Credit: 2	
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective:

Waste management term indicates how to minimize the load of waste generated in the environment. From different food industries different types of wastes are produced which needs to be treated in order to save our environment. This course helps gain knowledge about the several treatment (physical, chemical, biological) methods applied based on the parameters of waste load. Reuse and recycling of waste from the industries produce new products as well as it is environment friendly and cos effective.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Waste Treatment Parameters**	1.1 Constituents of suspended solids, volatile suspended solids, MLVSS, BOD, COD, Dissolve oxygen, Temperature, pH, Oxygen demands (BOD, COD, TOD), fat, oil and grease content, metal content, forms of nitrogen, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues. 1.2 Standards for disposal, measurement of organic content. 1.3 Analytical determination of BOD, COD, DO, acidity, alkalinity, TKN, phosphorous, sulphate, chloride, TSS, TDS, turbidity, conductivity. 1.4 Mathematical model for BOD, BOD curve.	**04**
Unit 2	**Stream Pollution and Measurement**	2.1 Nature of stream pollution, Self-purification of natural stream 2.2 Oxygen sag curve, Oxygen sag equation.	**02**

Unit 3	**Fundamental of Physical and Chemical Treatment**	3.1 **Fundamental of physical treatment** Objective of physical treatments, screening, flow equalization, mixing and flocculation, gravity separation, grit removal, skimming tank, sedimentation, Ideal sedimentation tank concept, high-rate clarification, flotation, aeration system. (No design principle only). 3.2 **Fundamental of Chemical treatment** Objective of chemical treatments, chemical coagulation, chemical precipitation, chemical oxidation, chemical neutralization and stabilization. (No design principle only)	**05**
Unit 4	**Fundamentals of Biological Treatment**	4.1 Objective of biological treatment, Types of biological process, Microbial growth kinetics, Substrate utilization kinetics. 4.2 Aerobic biological carbon oxidation, biological nitrification and denitrification, Biological phosphorous removal, Anaerobic biological oxidation.	**04**
Unit 5	**Biological Treatment Unit**	5.1 Types of Sewage filters (Intermittent sand filters, contact beds, trickling filters (only name, No description). 5.2 Trickling filters (construction of conventional trickling filter, loading, efficiency and performance of conventional trickling filter, merits and demerits of conventional trickling filter, high-rate filtration). 5.3 Biological treatment unit- Activated sludge process. 5.4 Biological treatment unit (Miscellaneous methods)- Oxidation ditch, stabilization pond (Oxidation Pond), Aerobic Pond, Anaerobic Pond, Facultative Pond, Aerated lagoons, Rotating biological contractors. (Only principle and application). 5.5 Anaerobic suspended and attached growth biological treatment process- Anaerobic contact process, anaerobic sludge blanket process, attached growth anaerobic process (only principle and application).	**08**
Unit 6	**Solid Waste Treatment**	6.1 Source and characteristics of solid wastes, Preliminary operation, thickening, stabilization, anaerobic digestion, aerobic digestion, conditioning, dewatering, sludge drying, incineration, disposal and landfilling (Only principle and application). 6.2 Composting, Vermicomposting. (Only principle and application)	**03**
Unit-7	**Industrial Waste Treatment**	7.1 Fruits and vegetable industry waste management (Types of waste generated of fruits and vegetable processing industry, treatment methods (physical, chemical, biological) applied to minimize waste load, by product utilization from fruits and vegetable processing industry). 7.2 Beverage and Distillery industry waste management (types of waste generated from beverage and distillery industry, treatment methods (physical, chemical, biological) applied to minimize waste load, by product utilization from beverage and distillery industry). 7.3 Meat, Fish and Poultry industry (type and characteristics of waste generated from meat and poultry industry, treatment methods (physical, chemical, biological) applied to minimize waste load, by product utilization from Meat , Fish and Poultry industry industry).	**04**

		7.4 Sugar industry waste management (type and characteristics of waste generated from Sugar industry, treatment methods (physical, chemical, biological) applied to minimize waste load, by product utilization from Sugar industry. 7.5 Dairy industry waste management (type and characteristics of waste generated from Dairy industry, treatment methods (physical, chemical, biological) applied to minimize waste load, by product utilization from Dairy industry).	
Sub Total: Total Lecture Classes			**30**
No. of classes required for conducting Internal Assessment examination			**04**
Grand Total:			**34**

3. Course Outcome: The students of the course should be able to

CO1: Explain fundamental concepts of waste treatment parameters and their measurement technique.
CO2: Interpret the mathematical model of BOD, Oxygen sag equation using the concept of waste treatment parameters.
CO3: Select between aerobic and anaerobic treatment method considering their working principle, application area, advantages and disadvantages
CO4: Identify the applicability of using different treatment methods (physical, chemical, biological) for specific food industries based on pollution characteristics and their economic aspects.
CO5: Illustrate the principles and the application area of various solid waste treatment methods.

4. Suggested Home Assignment/Student Activities:(At least two assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher:

Sl. No.	Topics for Home Assignment	Marks
1.	List down the parameters of waste water (physical, chemical, biological).	5
2.	Outline the methods of determining BOD, COD and DO of water.	5
3.	Interpret the significance of BOD curve.	5
4.	Describe the process of self-purification of natural stream.	5
5.	Explain the oxygen sag curve and its importance.	5
6.	Describe the various physical treatment methods applied to waste water treatment.	5
7.	Explain the chemical treatment methods applied to waste water.	5
8.	Write short notes on- nitrification and denitrification.	5
9.	Outline the objectives of biological treatments.	5
10.	Discuss the working principle of trickling filter with advantages and disadvantages.	5
11.	Outline the working principle of RBC.	5
12.	Compare between Aerobic, anaerobic and facultative pond.	5
13.	Describe anaerobic contact process and anaerobic sludge blanket process.	5
14.	Describe the process of vermicomposting, incineration, dewatering.	5
15.	Describe the methods applied to minimize waste load from dairy industry.	5
16.	Describe the methods applied to minimize waste load from meat and poultry industry.	5
17.	Describe the methods applied to minimize waste load from fruits and vegetable industry.	5
18.	Describe the methods applied to minimize waste load from beverage industry.	5
19.	Discuss the working principle of activated sludge process.	5
20.	Discuss the working principle of aerobic and anaerobic pond.	5
21.	Discuss the working principle of facultative pond.	5

5. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

6. Suggested Learning Resources:

i. Water and waste water Tech. 5th Ed. By Mark & Hammer, PHI.
ii. Industrial microbiology by L.E.Casida, New Age Publication.
iii. Environmental pollution by K.C.Agrawal.
iv. Environmental pollution control engireering by C.S. Rao.
v. Food processing waste management by green and Kramer (AVI)
vi. By- products from food industries: utilization and disposal by AFSI(I)
vii. Environmental Studies- By N.N.Basak
viii. Environmental Studies-By D .Srivastava
ix. Introduction to Environmental Engineering— By Dr.Manindra Nath Patra.
x. Environmental Engineering- By A.K.Jain
xi. Environmental Engineering---By G.Killy
xii. Environmental Engineering--- By Peavy, Rowe
xiii. Water and Waste Water Engineering— By S.Garg
xiv. Waste Water Engineering--By –Panmia
xv. The complete book on managing food processing industry waste- H. Panda, Asia Pacific Business Press Inc.2011.
xvi. Food Processing Waste Management : Treatment and Utilization Technology- V.K. Joshi and S.K. Sharma, New India Publishing Agency, 2011.

Name of the Course: Diploma in Food Processing Technology	
Category: Program Elective-IV	**Semester: Fifth**
Code No.: FPTPE302 (1)	**Theory: 100 Marks**
Course Title: Food Plant Design and Layout	**Examination Scheme:** External Assessment: **60 Marks** (End Semester Examination) Internal Assessment:**40 Marks** [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration: 17 weeks (Total hours per week = 2)	
Total lecture class/week: 2 hours	
Credit: 2	
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	

1. Objective:

To get an idea about project design – Its problem and solution
To understand concept of Cost analysis, cost indexes and market potential
To know about plant layout of different food processing units including their machineries and working process
To understand concept of instrumentation control, maintenance and computer aided design required for running a food plant.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Project Design**	1.1 Project design –Process design development, Types of designs, literature survey, cost estimation, factors affecting profitability of investments, 1.2 Optimum design (economic and operation), practical considerations in design, approach, feasibility survey, process development, possible problems that may arise and their solution, final design, construction and operation, design information from the literature. 1.3 Differences in the design of Food Processing and Non-Food Processing Plants 1.4 Need of different regulatory license required for establishing Food Industry	**06**

Unit 2	**Cost Analysis**	2.1 Cost analysis and cost indexes -Cash flow for industrial operations, factors affecting investment and production costs, cost factors in capital investment, and estimation of capital investment. 2.2 Comparative rating of product ideas: present market, market growth potential, costs, risks. Salient features of sales planning required for plant design.	**05**
Unit 3	**Food Plant Layout**	3.1 Plant layout –Definition, and principles, factors in planning layouts. Finding a product, preliminary screening of ideas Methods of layout planning –Unit areas concept, two –dimensional layouts, scale models. 3.2 Principles of plant layout –Storage layout, equipment layout, safety, plant expansion, floor space, utilities servicing, building, materials handling equipment, roads. Layout installations. 3.3 Types of plant layout –Salient features (explain by flow chart symbol of different equipments such as storage vessel, conveyors, feeders, separators, blender, grinder along with process control) of horticultural, rice, maize, pulses, oil seeds, poultry, fish, meat, spice, beverages, alcoholic beverage, milk and milk product and bakery plants. 3.4 Location selection criteria –Plant location, factors in selecting a plant, selection of the plant site, preparation of the layout.	**09**
Unit 4	**Flow Diagrams**	4.1 Flow diagrams -qualitative and quantitative flow diagrams. Selection of equipments and processes - Plant capacity – Equipment design and specifications, Comparison of different processes, batch versus continuous operation. 4.2 Flow Chart for plant design, problem statement (identification stage and looking for a need), materials of construction and energy balance, equipment design and selection, scaleup in design, safety factors, specifications, problems, economics.	**05**
Unit-5	**Process Control and Handling**	5.1 Process and controls-Control systems, instrumentation control, maintenance, computer aided design. 5.2 Handling equipments -Selection, factors, pumps, piping, fittings, solid feeders, plant layout. 5.3 Plant elevation -Requirement of plant building and its components, foundation for equipment and dynamic loading, flooring, walls, roof, illumination, air-conditioning. 5.4 Labour requirement for processing plant -Labour costs, Labour handling, maintenance and repairs, common denominator, plant installation, power and power transmission systems.	**05**
Sub Total: Total Lecture Classes			**30**
No. of classes required for conducting Internal Assessment examination			**4**
Grand Total:			**34**

3. **Course Outcome**: The students of the course should be able to

CO1: Define project design – Its problem and solution.
CO2: Explain concept of cost analysis, cost indexes and market potential.
CO3: Illustrate plant layout of different food processing units including their machineries and working process.
CO4: Outline instrumentation control, maintenance and computer aided design required for running a food plant.
CO5: Develop idea about equipments handling and manpower handling.

4. Suggested Home Assignment/Student Activities:(At least Two assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher.

Sl. No.	Topics for Home Assignment	Marks
1.	Prepare feasibility survey report of a bakery unit.	5
2.	Prepare cost analysis report of a pulse and cereal plant.	5
3.	Design a plant layout using symbol only of horticultural unit.	5
4.	Design a plant layout using symbol only of edible oil unit.	5
5.	Design a plant layout using symbol only of poultry unit.	5
6.	Design a plant layout using symbol only of fish unit.	5
7.	Design a plant layout using symbol only of bakery unit.	5
8.	Write differences between batch versus continuous operation with example.	5
9.	Write Note on scaleup in a project design.	5
10.	Write differences between design of Food Processing and Non-Food Processing Plants.	5
11.	Design a plant layout using symbol only of Milk processing unit.	5
12.	Design a plant layout using symbol only of soft drinks beverage unit.	5
13.	Design a plant layout using symbol only of alcoholic beverage unit.	5
14.	Design a plant layout using symbol only of ice cream unit.	5
15.	Design a plant layout using symbol only of spice production unit.	5
16.	Design a plant layout using symbol only of meat processing unit.	5
17.	Prepare feasibility survey report of a Dairy unit.	5
18.	Prepare feasibility survey report of an alcoholic beverage unit.	5
19.	Prepare feasibility survey report of soft drinks beverage unit.	5
20.	Prepare feasibility survey report of meat and fish unit.	5

5. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

6. Suggested Learning Resources:

i. Food Plant Design, by Antonio Lopez-Geomez and Gustavo V. Barbosa-Canovas, CRC press, Taylor & Francis, New York.
ii. Food Plant Economics, by Zacharias B. Maroulis and George D. Saravacos, CRC press, Taylor & Francis, New York.
iii. Plant Design and Economics for Chemical Engineers by Peter, M.S. and Timmerhaus, K.D. McGraw Hill.

Name of the Course: Diploma in Food Processing Technology	
Category: Program Elective-IV	**Semester: Fifth**
Code No.: FPTPE302 (2)	**Theory: 100 Marks**
Course Title: Food Plant Maintenance and Hygiene	**Examination Scheme:** External Assessment: **60 Marks** (End Semester Examination) Internal Assessment: **40 Marks** [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration: 17 weeks (Total hours per week = 2)	
Total lecture class/week: 2 hours	
Credit: 2	
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective:

To know about standard operating procedure of different food processing units.
To get Knowledge to control different emergency situations during running a food plant.
To acquire Knowledge of Food Safety Management System, traceability and product recall.
To get an extensive idea about Food plant sanitation – Its general requirements and cleaning procedures.
To get Idea about personal hygiene and operational hygiene required in a food industry.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Food Plant Maintenance**	1.1 Prepare standard operating procedure for different unit operation of rice, maize, pulses, bakery, oil seeds, poultry, fish, meat, spice, beverages, milk plant. 1.2 Develop precautionary method to control emergency situation such as Accident or sudden illness of worker, Power supply failure, Machine failure, Pollution and suffocation due to contamination, Waterlog condition, Fire outbreak, Disturbance by external public. 1.3 Development of Food Safety Team and FSMS system. Validation, verification and improvement required for the FSMS system. Role of Quality control department in Food Industry. 1.4 Define procedure to control the non-conformity, correction of non-conformity. 1.5 Concept of traceability and product recall.	**08**

Unit 2	**Food plant Sanitation**	2.1 Food contamination by microorganisms, effective control of micro-organisms, importance in food sanitation, micro-organisms as indicator of sanitary quality. 2.2 Food plant sanitation-Environmental protection, regulations, pollution control, air pollution abatement, particulate removal, noxious gas removal, thermal pollution control, recycling, CIP. 2.3 Effective detergency and cleaning practices: Importance of cleaning technology, physical and chemical factors in cleaning, classification and formulation of detergents and sanitizers, cleaning practices. Role of sanitation, general sanitary consideration and sanitary evaluation of food plants. 2.4 Develop Pre-requisite program for the following operations: Facility cleaning, Cleaning of equipments and surrounding area, Water management (Source of water, quality of water, purification and disinfection of water preventing contamination), Waste management (different types of waste and there disposal), Pest and Rodent control 2.5 Mention the sanitary requirements of Diary industry, Fruits and vegetable industry, soft drink beverage industry, Alcoholic beverage industry, bakery and confectionary industry and Slaughter house.	**09**
Unit 3	**Personal Hygiene**	3.1 General principle of food hygiene, Hygiene in rural and urban areas in relation to food preparation, personal hygiene and food handling habits. Establishing and maintaining sanitary practices in food plants. Prepare Food Safety objectives of an organization. 3.2 Develop policies by FBO to maintain Hygiene: Visitor's policy, Glass, brittle plastic, metal and wood policy, Jewelry policy, Personal hygiene policy, Allergen and GMO policy, Discard policy. 3.3 Mention facilities required in a FBO to maintain proper hygiene of the worker. 3.4 Training program required to maintain proper personal hygiene.	**06**
Unit 4	**Operational Hygiene**	Food hygiene and safety requirement for: 4.1 Procurement of the raw materials, ingredients, chemicals and packaging materials. 4.2 Food contact surface area such as vessels, reactor, utensils tables –and prevention of cross contamination. 4.3 Production house - Standard sanitation operating procedures of the production unit during processing activity and control measures to prevent the risks.	**07**

		4.4 Warehouse- Aerated, refrigerated and controlled atmospheric storage, Conventional & Modern control measures, storage structures for fruits, vegetables, meat and marine products. 4.5 Transportation- Cross contamination, Time and temperature effect on the sanitation of the transporting vehicle. Handling practices and Personal hygiene affects the sanitation during transportation. 4.6 Cold Chain- Personal hygiene practices that effects the sanitation during cold chain management of the food products	
Sub Total: Total Lecture Classes			**30**
No. of classes required for conducting Internal Assessment examination			**04**
Grand Total:			**34**

3. Course Outcome: The students of the course should be able to

CO1: Explain standard operating procedure of different food processing units and different emergency situations during running a food plant.
CO2: Explain concept of Food Safety Management System, traceability and product recall.
CO3: Illustrate Food plant sanitation – Its general requirements and cleaning procedures.
CO4: Discuss different policies maintained in food industries.
CO5: Develop knowledge of personal hygiene and operational hygiene required in a food industry.

4. Suggested Home Assignment/Student Activities:(At least two assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher:

Unit No.	Topics for Home Assignment	Marks
1.	Draw a flow diagram of a traceability plan.	5
2.	Write personal hygiene policy of a food plant.	5
3.	Write visitor's policy of a food plant.	5
4.	Write operational hygiene required for slaughter house	5
5.	Write operational hygiene required for warehouse.	5
6.	Write Food hygiene and safety requirement for Procurement of the raw materials, ingredients, chemicals and packaging materials.	5
7.	Write Food hygiene and safety requirement for Food contact surface area such as vessels, reactor, utensils tables –and prevention of cross contamination.	5
8.	Write Food hygiene and safety requirement for Production house.	5
9.	Write Food hygiene and safety requirement in Cold Chain system.	5
10.	Develop Pre-requisite program for Facility cleaning, Cleaning of equipments and surrounding area.	5
11.	Develop Pre-requisite program for Water management.	5
12.	Develop Pre-requisite program for Waste management.	5
13.	Write sanitary requirement of different unit operation in a bakery unit.	5
14.	Write sanitary requirement of different unit operation in a fish and meat unit	5
15.	Write sanitary requirement of different unit operation in a spice unit.	5
16.	Write sanitary requirement of different unit operation in a dairy unit.	5

17.	Write sanitary requirement of different unit operation in cereal and pulse unit.	5
18.	Write sanitary requirement of different unit operation in soft drink unit.	5
19.	Write sanitary requirement of different unit operation in alcoholic beverage unit.	5
20.	Write sanitary requirement of different unit operation in canning unit.	5
21.	Write standard operating procedure for different unit operation of rice, maize, pulses unit.	5
22.	Write standard operating procedure for different unit operation of bakery unit.	5
23.	Write standard operating procedure for different unit operation of poultry, fish, meat unit.	5
24.	Write standard operating procedure for different unit operation of dairy unit.	5
25.	Write standard operating procedure for different unit operation of soft drink beverage unit.	5
26.	Write standard operating procedure for different unit operation of spice unit.	5
27.	Write standard operating procedure for different unit operation of alcoholic beverage unit.	5

5. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

6. Suggested Learning Resources:

i. Principles of Food Sanitation by Marriott and Norman, G.
ii. Hygiene and Sanitation in Food Industry by S. Roday, TMH
iii. Guide to Improve Food Hygiene by Gaston and Tiffney, TMH.
iv. Practical Food Microbiology & Technology by Harry H. Weiser, Mountney, J. and Gord, W.W.
v. Food Poisoning and Food Hygiene by Betty C. Hobbs, London publication.

Name of the Course: Diploma in Food Processing Technology	
Category: Program Elective-IV	**Semester: Sixth**
Code No.: FPTPE 302 (3)	**Theory: 100 Marks**
Course Title: Food Metabolism and Nutrition	**Examination Scheme:**
Duration: 17 weeks (Total hours per week = 2)	External Assessment: **60 Marks** (End Semester Examination)
Total lecture class/week: 2 hours	Internal Assessment:**40 Marks**
Credit: 2	[Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective:

To develop the knowledge of metabolism of carbohydrate, protein and lipid.
To understand function of minerals and vitamins in maintaining the body metabolism.
To know the energy content of foods and measurement methods of energy expenditure.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Energy**	1.1 Energy content of foods. Measurement of Energy Expenditure: BMR, RMR, Thermic effect of feeding and physical activity. 1.2 RDA Estimating energy requirement for individuals and groups, Food groups, Balanced diet.	**05**
Unit 2	**Concept of Metabolism**	2.1 Transport process across cell membranes. Introduction, Classification and Nutritional importance of nutrients- Carbohydrate, Protein and Lipids.	**03**
Unit 3	**Carbohydrates**	3.1 Type, Source, Function, Dietary requirements and physiological significance. Glycemic index of foods. 3.2 Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis (in brief), Citric acid cycle & its significance, Gluconeogenesis (in brief), Regulation of blood glucose level.	**06**
Unit 4	**Proteins**	4.1 Type, Source, Function, Protein Quality (BV, PER, NPU), 4.2 Digestion and Absorption, Factors affecting protein bio-availability including Anti nutritional factors.	**06**

		4.3 Evaluation methods and improvement of protein quality. PEM. Transamination, Deamination, Oxidation of amino acid, Ammonia formation & transport. 4.4 Urea cycle. synthesis and breakdown of body protein.	
Unit 5	**Lipids**	5.1 Type, Source, Function, Dietary requirements, EFA. 5.2 Transport of lipoprotein, Prostaglandins. Beta oxidation of fatty acids, Ketosis, Cholesterol & it's clinical significance.	**06**
Unit 6	**Minerals and Vitamins**	6.1 Bioavailability, metabolism, function, RDI, deficiency and toxicity, interactions with other nutrients. 6.2 Macro minerals: calcium, magnesium, sodium, potassium. Micro minerals: Iron, copper, zinc, iodine. Trace minerals: selenium, cobalt, chromium. 6.3 Type, Source, Function, Dietary requirements, Deficiency and Toxicity of Fat soluble and Water-soluble vitamins.	**04**
Sub Total: Total Lecture Classes			**30**
No. of classes required for conducting Internal Assessment examination			**04**
Grand Total:			**34**

3. Course Outcome: The students of the course should be able to

CO1: Discuss the energy content of foods and measurement methods of energy expenditure.
CO2: Interpret the concept of metabolism
CO3: Illustrate the metabolism of carbohydrate, protein and lipid.
CO4: Explain the function of minerals and vitamins in maintaining the body metabolism.

4. Suggested Home Assignment/Student Activities: (At least Two assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher:

Unit No.	Topics for Home Assignment	Marks
1.	Describe the method of measurement of energy content of food.	5
2.	Describe the method of estimating energy requirement for individuals and groups.	5
3.	Explain the transport process across the cell membrane.	5
4.	Classify carbohydrates, proteins and lipids.	5
5.	Explain glycaemic index of food.	5
6.	Differentiate between Glycogenesis and Glycogenolysis.	5
7.	Illustrate the method of regulation of blood glucose level.	5
8.	Explain the role of anti-nutritional factors.	5
9.	Differentiate between transamination and deamination process.	5
10.	Explain the function of essential fatty acids.	5
11.	Illustrate the process of beta oxidation of fatty acids.	5
12.	Explain the clinical significance of cholesterol.	5

13.	Describe the toxicity of fat-soluble vitamins.	5
14.	Describe the toxicity of water-soluble vitamins.	5
15.	Explain the role of trace minerals.	5
16.	Illustrate the synthesis of protein in human body.	5
17.	Describe the factors that affect bioavailability of protein.	5
18.	Describe the methods of improvement of protein quality.	5
19.	Explain the evaluation method of protein quality.	5
20.	Differentiate between micro mineral and trace mineral.	5

5. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

6. Suggested Learning Resources:

i. Principles of Biochemistry by Albert L. Leninger, CBS Publishers & Distributors, New Delhi.

ii. Biochemistry Laboratory Techniques by Sterling Chaykin, Wiley Eastern Pvt. Ltd.

iii. Foods Facts & Principles by N. Shakuntala Manay & M. Shadaksharaswamy, New Age International.

iv. Food Science by N.N. Potter, CBS Publishers & Distributors Pvt Ltd, India.

v. Food Chemistry by L. H. Meyer, Publisher: Reinhold.

vi. Food Analysis & Practice by Y. Pamaranz, Publisher: AVI.

vii. Text Book of Biochemistry by Webb, Todd, Mason, Macmillan Publishing Company.

viii. Principles of Food Science Vol. I by Fennema, Karrel.

ix. Food Science by B. Srilaxmi, New Age international.

x. Principles of Food Science / Karek & L.M. Delker.

Name of the Course: Diploma in Food Processing Technology	
Category: Program Elective-IV	**Semester: Sixth**
Code No.: FPTPE 302 (4)	**Theory: 100 Marks**
Course Title: Tea processing and Brewing Technology	**Examination Scheme:**
Duration: 17 weeks (Total hours per week = 2)	External Assessment: **60 Marks** (End Semester Examination)
Total lecture class/week: 2 hours	Internal Assessment: **40 Marks**
Credit: 2	[Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective:

To enhance practical knowledge on improved techniques of varieties of tea processing method and tea brewing technology.

To demonstrate the tea analysis, tea testing and Regulatory Standards and Requirements of tea and tea products.

To understand Tea Garden economics, plantation labour act, industrial dispute act, minimum wage act, tea act, worker welfare and labour laws, various schemes of Tea Board and other govt. agencies.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Tea Biochemistry and Manufacturing**	1.1 Biochemical aspects of tea production, quality parameters, leaf handling and transportation, post-harvest management, transportation, causes of leaf damage. 1.2 Tea processing machineries, tea manufacturing methods, different types of tea, new development in tea processing, sorting, grading and packaging of tea, packaging material and keeping quality of tea. 1.3 Manufacturing process of CTC tea, Orthodox tea, Oolong tea, green tea, -ingredients, process flow-sheet, process description, machineries.	**10**
Unit 2	**Regulatory Standards and Requirements**	2.1 MRL problem in tea and its global implications, HACCP, ISO, Trustea, Fairtrade, RA, PPC and its implication in tea industry.	**04**

Unit 3	**Tea Tasting and Analysis**	3.1 Organoleptic and chemical principles, terminologies in tea tasting. 3.2 Analysis and quality evaluation of tea (moisture, ash, crude fiber, iron fillings)	**04**
Unit 4	**Brewing Technology**	4.1 Tea brewing method and process, Blended Brewing of tea with botanical ingredients, Tea to Spice Drinks, Cold Brewing of tea, tea brewing equipments. 4.2 Nonconventional tea products (Cold- and hot-soluble instant tea, flavored tea, decaffeinated tea, tea concentrate, herbal tea, tea bag). 4.3 Value addition of teas – addition of other botanical parts in tea / blending with Indian herbs like aswagandha , mulethi , adrak and tulsi . Medicinal value of tea, Health benefits of Tea.	**06**
Unit 5	**Human Resource Management and Accounting**	5.1 Use of computer for data storage and transfer, industrial relations and labour management, accounting procedures, material management, fixed and variable expenses, cost benefit, break even yield, pay back, 5.2 Tea Garden economics, plantation labour act, industrial dispute act, minimum wage act, tea act, worker welfare and labour laws, various schemes of Tea Board and other govt. agencies.	**06**
Sub Total: Total Lecture Classes			**30**
No. of classes required for conducting Internal Assessment examination			**04**
Grand Total:			**34**

3. Course outcome: The students of the course should be able to

CO1: Explain the techniques of varieties of tea processing method from tea leafs.
CO2: Illustrate the method of production and quality analysis of different tea products.
CO3: Illustrate the method of tea brewing technology and application.
CO4: Develop basic knowledge and idea about tea garden economics, tea act, worker welfare and labour laws and various schemes of Tea Board and other govt. agencies.

4. Suggested Home Assignment/Student Activities: (At least two assignments)

Other than practice work in classroom, students should conduct the following suggested activities in group or individual, which are suitable for this subject as per instruction of the subject teacher:

Unit No.	Topics for Home Assignment	Marks
1.	Explain Biochemical aspects of tea production.	5
2.	Explain post-harvest management transportation of tea leafs.	5
3.	Illustrate Tea processing machineries.	5
4.	Discuss Manufacturing process of CTC tea.	5
5.	Discuss Manufacturing process of Orthodox tea.	5
6.	Discuss Manufacturing process of Oolong tea.	5
7.	Discuss Manufacturing process of Green tea.	5

8.	Illustrate Regulatory Standards and Requirements for tea.	5
9.	Explain Blended Brewing of tea with botanical ingredients.	5
10.	Discuss Manufacturing process of Cold- and hot-soluble instant tea.	5
11.	Discuss Manufacturing process of decaffeinated tea.	5
12.	Discuss Manufacturing process of tea concentrate.	5
13.	Discuss Manufacturing process of herbal tea and flavored tea.	5
14.	Discuss Manufacturing process of tea bag.	5
15.	Discuss Tea Garden economics.	5

5. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

6. Suggested Learning Resources:

i Tea: Production and Processing, Barundeb Banerjee, Oxford & IBH Publishing Company.
ii. Foods Facts & Principles by N. Shakuntala Manay & M. Shadaksharaswamy, New Age International.
iii. Food Science by N.N. Potter, CBS Publishers & Distributors Pvt Ltd, India.

Name of the Course: Diploma in Food Processing Technology	
Category: Humanities and Social Science	**Semester: Sixth**
Code No.: HS302	**Theory: 100 Marks**
Course Title: Entrepreneurship and Start-ups	**Examination Scheme:**
Duration: 17 weeks (Total hours per week = 3)	External Assessment: **60 Marks** (End Semester Examination)
Total lecture class/week: 3 hours	Internal Assessment: **40 Marks**
Credit: 3	[Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective:

To raise awareness, knowledge and understanding of enterprise/ entrepreneurship.
To motivate and inspire students toward an entrepreneurial career.
To understand venture creation process and to develop generic entrepreneurial competences.
To introduce students to the basic steps required for planning, starting and running a business.
To familiarise students with the different exit strategies available to entrepreneurs.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Entrepreneurship – Introduction and process**	1.1 Concept, Competencies, Functions and Risks of entrepreneurship 1.2 Entrepreneurial Values& Attitudes and Skills 1.3 Mindset of an employee/manager and an entrepreneur 1.4 Types of Ownership for Small Businesses o Sole proprietorship o Partnerships o Joint Stock company- public limited and private limited companies 1.5 Difference between entrepreneur and Intrapreneur	**10**

Unit 2	**Preparation for Entrepreneurial Ventures**	2.1 Business Idea- Concept, Characteristics of a Promising Business Idea, Uniqueness of the product or service and its competitive advantage over peers. 2.2 Feasibility Study – Concept – Locational, Economic, Technical and Environmental Feasibility. Structure and Contents of a standard Feasibility Study Report. 2.3 Business Plan – Concept, rationale for developing a Business Plan, Structure and Contents of a typical Business Plan. 2.4 Project Report- Concept, its features and components. 2.5 Basic components of Financial Statements- Revenue, Expenses (Revenue & capital exp), Gross Profit, Net Profit, Asset, Liability, Cash Flow, working capital, Inventory. Funding Methods-Equity or Debt. Students are just expected to know about the features and key inclusions under, Business Plan and Project Report. <u>They **may not** be asked to prepare a Business Plan/ Project Report/ Project Feasibility Report in the End of Semester Examination.</u>	**20**
Unit 3	**Establishing Small Enterprises**	3.1 Legal Requirements and Compliances needed for establishing a New Unit- o NOC from Local body o Registration of business in DIC o Statutory license or clearance o Tax compliances	**03**
Unit 4	**Start-up Ventures**	4.1 Concept & Features. 4.2 Mobilisation of resources by start-ups: Financial, Human, Intellectual and Physical. 4.3 Problems and challenges faced by start-ups. 4.4 Start-up Ventures in India – Contemporary Success Stories and Case Studies to be discussed in the class. Case studies have been included in the syllabus to motivate and inspire students toward an entrepreneurial career from the success stories. **<u>No questions are to be set from the case studies.</u>**	**04**
Unit 5	**Financing Start-up Ventures in India**	5.1 Communication of Ideas to potential investors – Investor Pitch. 5.2 Equity Funding, Debt funding – by Angel Investors, Venture Capital Funds, Bank loans to start-ups. 5.3 Govt Initiatives including incubation centre to boost start-up ventures. 5.4 MSME Registration for Start-ups –its benefits.	**06**

Unit 6	**Exit Strategies for Entrepreneurs**	6.1 Merger and acquisition exit, Initial Public Offering (IPO), Liquidation, Bankruptcy – **Basic Concept only**	**02**
Sub Total: Total Lecture Classes			**45**
No. of classes required for conducting Internal Assessment examination			**06**
Grand Total:			**51**

3. Course Outcome: After completing the course students will able to:

CO 1	Identify qualities of entrepreneurs, develop awareness about entrepreneurial skill and mindset and express knowledge about the suitable forms of ownership for small business
CO 2	Comprehend the basics of Business idea, Business plan, Feasibility Study report, Project Report and Project Proposal
CO 3	Understand the concept of start-up business and recognise its challenges within legal framework and compliance issues related to business.
CO 4	Make a Growth Plan and pitch it to all stakeholders and compare the various sources of funds available for start-up businesses

4. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. Suggested Learning Resources:

Sl. No.	Title of Book	Author	Publication
1.	Entrepreneurship Development	Sangeeta Sharma	Prentice Hall of IndiaLearning Private Ltd
2.	Entrepreneurship Development	S. Anil Kumar	New Age International
3.	Fundamentals of Entrepreneurship	Sangram Keshari Mohanty	Prentice Hall of India Learning Private Ltd
4.	Fundamentals of Entrepreneurship	Dr. G.K. Varshney	Sahitya Bhawan Publication
5.	Managing New Ventures: Concepts and Caseson Entrepreneurship	Anjan Raichaudhuri	Prentice Hall of India Learning Private Ltd
6.	How to Start a Business in India	Simon Daniel	Buuks, Chennai
7.	Entrepreneurship and Small Business Management	S.S. Khanka	S. Chand & Sons, New Delhi
8.	Entrepreneurship Development and Business Ethics	Abhik Kumar Mukherjee & Shaunak Roy	Oxford University Press
9.	Entrepreneurship Development and Business Ethics	Dr B Chandra & Dr B Biswas	Tee Dee Publications
10.	Entrepreneurship Development Small Business Entrepreneurship	Poornima Charantimath	Pearson Education India

Name of the Course: Diploma in Food Processing Technology	
Category: Open Elective Course-I	**Semester: Sixth**
Code No.: FPTOE302	**Theory: 100 Marks**
Course Title: Engineering Economics and Project Management	**Examination Scheme:** External Assessment: **60 Marks** (End Semester Examination) Internal Assessment: **40 Marks** [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration: 17 weeks (Total hours per week = 3)	
Total lecture class/week: 3 hours	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. Objective: To acquire knowledge of basic economics to facilitate the process of economic decision making.
To acquire knowledge on basic financial management aspects.
To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.
To develop an understanding of key project management skills and strategies.

2. Theory Components:

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Introduction, Theory of Demand and Supply**	1.1 Introduction to Engineering Economics, the relationship between Engineering and Economics 1.2 Resources, scarcity of resources, and efficient utilization of resources. 1.3 Opportunity cost, rationality costs, and benefits 1.4 Theory of Demand: the law of demand, different types of demand, determinants of demand, demand function, price elasticity of demand. 1.5 Theory of Supply: determinants of supply, supply function. 1.6 Market mechanism: Equilibrium, basic comparative static analysis (Numerical problems)	**09**

Unit 2	**Theory of Production and Costs**	2.1 Concept of production (goods & services), Different factors of production (fixed and variable factors), Short-run Production function (Graphical illustration), and long run production function (returns to scale). 2.2 Theory of Cost: Short-run and long-run cost curves with graphical illustration, basic concept on total cost, fixed cost, variable cost, marginal cost, average cost etc. 2.3 Economic concept of profit, profit maximization (numerical problems)	**10**
Unit 3	**Different Types of Market and Role of Government**	3.1 Perfect Competition: Features of Perfectly Competitive Market. 3.2 Imperfect Competition: Monopoly, Monopolistic Competition, and Oligopoly. 3.3 Role of government in Socialist, Capitalist and Mixed Economy structure with example.	**04**
Unit 4	**Concept of Project**	4.1 Definition and classification of projects) 4.2 Importance of Project Management. 4.3 Project life Cycle [Conceptualization→Planning→Execution→Termination]	**04**
Unit 5	**Feasibility Analysis of a Project**	5.1 Economic and Market analysis. 5.2 Financial analysis: Basic techniques in capital budgeting– Payback period method, Net Present Value method, Internal Rate of Return method. 5.3 Environmental Impact study–adverse impact of the project on the environment. 5.4 Project risk and uncertainty: Technical, economical, socio-political, and environmental risks. 5.5 Evaluation of the financial health of a project–Understanding the basic concept of Fixed & Working Capital, Debt & Equity, Shares, Debentures etc., and different financial ratios like Liquidity Ratios, Activity Ratios, Debt-equity ratio & Profitability Ratio (Basic concept only). N.B: Knowledge of financial statements is not required; for the estimation of ratios the values of the relevant variables will be provided.	**10**
Unit 6	**Project Administration**	6.1 Gantt Chart– a system of bar charts for scheduling and reporting the progress of a project (basic concept). 6.2 Concept of Project Evaluation and Review Technique (PERT) and Critical Path method (CPM): basic concept and application with real-life examples.	**08**
Sub Total: Total Lecture Classes			**45**
No. of classes required for conducting Internal Assessment examination			**06**
Grand Total:			**51**

3. Course outcome: The students of the course should be able to

CO1: Explain basic economics to facilitate the process of economic decision making.
CO2: Illustrate basic financial management aspects.
CO3: Develop the idea of project plan from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.
CO4: Develop key project management skills and strategies.

4. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. Suggested Learning Resources:

i. Principles of Economics – Case and Fair, Pearson Education Publication
ii. Principles of Economics – Mankiw, Cengage Learning
iii. Project planning, analysis, selection, implementation and review – Prasannachandra–Tata McGraw Hill.
iv. Project Management – Gopala Krishnan – Mcmillan India Ltd

Name of the Course: Diploma in Food Processing Technology	
Category: Open Elective II	**Semester: Sixth**
Code No.: FPTOE304 (1)	**Theory: 100 Marks**
Course Title: Environmental Science and Engineering	**Examination Scheme:**
Duration: 17 weeks (Total hours per week = 3)	External Assessment: **60 Marks** (End Semester Examination)
Total lecture class/week: 3 hours	Internal Assessment: **40 Marks**
Credit: 3	[Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. **Objective:** To increase the awareness towards Environmental Science and Engineering.
   To recognize and apply the role of technology towards Environmental Science and Engineering.
   To know the method and tools used for Environmental Science and Engineering.
   To know about the environmental pollution management act.

2. **Theory Components:**

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Environment and Ecology**	1.1 Classification of Environment 1.2 Environmental descriptors 1.3 Environmental quality and descriptive parameters 1.4 Ecology: Definition and classification 1.5 Environmental impact on ecology	**08**
Unit 2	**Water pollution and Pollutants (Natural and Anthropogenic)**	2.1 Ground water: Sources and quality analysis 2.2 Surface water: Sources and quality analysis 2.3 Quality parameters in water treatment along with flow-sheets 2.4 Basic processes for potable water supply (Detailed technology not necessary) 2.5 Water pollution: Surface and ground water pollution, types of pollutants 2.6 Mode of water pollution 2.7 Parameters to be assessed for water pollution (Turbidity, pH, total suspended solids, total solids, BOD and COD: Definition, calculation) 2.8 Chemistry aspect for water pollution 2.9 Control of water pollution (Description only) 2.10 Fundamental of water treatment techniques.	**10**

Unit 3	**Air quality, Air Pollution and Control, Noise Pollution**	3.1 Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler) 3.2 Air Pollutants: Types, Units of air pollutants 3.3 Atmospheric physics for air pollution 3.4 Particulate Pollutants: Effects and control strategies (Bag filter, Cyclone separator, Electrostatic Precipitator) 3.5 Advanced air pollution control methods 3.6 Noise pollution: sources of pollution, measurement of noise pollution 3.7 Noise measuring devices and their demonstration	**10**
Unit 4	**Solid Waste and Soil Pollution**	4.1 Definition of solid waste 4.2 Classification of solid waste 4.3 Overview on municipal, industrial, hazardous, hospital, plastic, E-waste etc. 4.4 Solid waste management and disposal process. 4.5 Soil pollution, Poor Fertility, Septicity, Concentration of Infecting Agents in Soil 4.6 Leaching and its impact on soil pollution.	**06**
Unit 5	**Renewable Sources of Energy**	5.1 Energy Resources: Energy scenario, national and international status. 5.2 Solar Photovoltaics: Solar radiation and types, basic working principle of solar PV, solar cells and types, water pumping and applications of solar PV. 5.3 Solar Thermal system: basic working principle and applications of solar thermal energy, solar water heater and types, solar cooking, solar pond, Solar still etc. 5.4 Wind energy systems: basic principle, types of wind turbines, application of wind energy, 5.5 Bio-energy systems: bio thermal and chemical basic principle, gasifier and digesters. 5.6 Hydro energy systems: small and micro hydro systems and its basic working. 5.7 Geothermal energy: Basic working principle, types and application of geothermal energy. 5.8 Ocean & Tidal Energy: Basic working principle, applications and types of different types of energy generation through ocean and tidal systems.	**09**
Unit 6	**Environment Legislation System and Rules**	6.1 Environmental protection rules. 6.2 Sustainable environmental management.	**02**
Sub Total: Total Lecture Classes			**45**
No. of classes required for conducting Internal Assessment examination			**06**
Grand Total:			**51**

3. **Course Outcome:** The students of the course should be able to

CO1	Recognize the relevance and the concept of Environmental Science and Engineering and different world-wide activities on this area.
CO2	Illuminate the different types of environmental pollutant, their effects and their sustainable solutions.
CO3	Discuss the environmental regulations act. and standards.
CO4	Gather basic idea about conventional and non-conventional energy resources.
CO5	Demonstrate the broad perspective of Environmental Science practices by utilizing engineering knowledge and principles.

4. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. Suggested Learning Resources:

Text Books:

i. Environmental Studies- By N.N.Basak
ii. Environmental Studies-By D .Srivastava
iii. Introduction to Environmental Engineering— By Dr.Manindra Nath Patra.
iv. Environmental Engineering- By A.K.Jain

Reference Books:

i. Environmental Engineering---By G.Killy
ii. Environmental Engineering--- By Peavy, Rowe
iii. Water and Waste Water Engineering— By S.Garg
iv. Waste Water Engineering--By -Panmia
v. Non-conventional Energy Sources-4th Edition, By Prasad Rajesh K and Ojha
vi. Non-conventional Energy Resources—By Chauhan and Srevastava
vii. Non-conventional Energy Sources---By G.D.Rai (Khanna Publisher)
viii. Ecology --By -Odum
ix. Ecology---By -Das & Das
x. Environmental Law ---By -Gurdip Sing
xi. Environmental Law----By Jaiswal Jaiswal Jaiswal
xii. Environmental Law in India ---By -P.Leela Krishnan
xiii. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
xiv. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
xv. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency
Publications-Rating System, TERI Publications - GRIHA Rating System

Name of the Course: Diploma in Food Processing Technology	
Category: Open Elective II	**Semester: Sixth**
Code No.: FPTOE304 (2)	**Theory: 100 Marks**
Course Title: Industrial Management	**Examination Scheme:** External Assessment: **60 Marks** (End Semester Examination) Internal Assessment: **40 Marks** [Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Duration: 17 weeks (Total hours per week = 3)	
Total lecture class/week: 3 hours	
Credit: 3	
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. **Objective:** This subject provides the students of polytechnics with an exposure to the art and science of management principles, functions, techniques and skills that are essential for maximizing attainment of the organizational goals with the available manpower and resources. Upon successful completion of this subject, the students shall be equipped with the fundamental knowledge of management which should make them confident in facing the challenges of their responsibilities in the different organizational scenarios.

2. **Theory Components:**

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Overview Of Business**	1.1. Types of Business -Service -Manufacturing -Trade 1.2. Industrial sectors Introduction to: -Engineering industry -Process industry -Textile industry -Chemical industry -Agro industry 1.3 Globalization Introduction - Advantages & disadvantages w.r.t. India 1.4 Intellectual Property Rights (I.P.R.)	**04**

Unit 2	**Management Process**	2.1 What is Management? -Evolution - Various definitions - Concept of management -Management is the combination of art and science - Levels of management -Administration & management - Scientific management by F.W.Taylor 2.2 Principles of Management (14 principles of Henry Fayol) 2.3 Functions of Management -Planning -Organizing -Directing -Controlling 2.4 Social responsibility and Environmental dimension of management.	**05**
Unit 3	**Organizational Management**	3.1 Organization:- - Definition -Steps in organization 3.2 Types of organization - Line - Line & staff - Functional - Project 3.3 Departmentation - Centralized & Decentralized -Authority & Responsibility - Span of Control 3.4 Forms of ownership - Proprietorship -Partnership - Joint stock - Co-operative Society - Govt. Sector	**06**
Unit 4	**Human Resource Management**	4.1 Personnel Management - Introduction - Definition -Objectives -Functions 4.2 Staffing - Introduction to HR Planning -Recruitment Procedure 4.3 Personnel– Training & Development - Types of training - Induction -Skill Enhancement 4.4 Grievance handling 4.5 Leadership, Leadership quality, Leadership style -Motivation - Maslow's Theory of Motivation 4.6 Introduction to -ESI Act -Workmen Compensation Act	**08**

Unit 5	**Financial Management**	5.1. Financial Management - Objectives & Functions 5.2. Break Even Analysis -Introduction -Graphical representation -Significance -Limitations 5.3. Introduction to – -Excise Tax - Income Tax -GST -Custom Duty	**06**
Unit 6	**Materials Management**	6.1 Objectives and function of Materials Management 6.2. Purchase Procedure - Objects of Purchasing - Functions of Purchase Dept. - Steps in Purchasing 6.2 Economic Order Quantity (EOQ) - Introduction & Graphical Representation 6.3 Inventory Management. -Meaning & Objectives 6.4 ABC Analysis, VED Analysis 6.5 Stores function, -BIN card, -Pricing of materials -Store verifications	**08**
Unit 7	**Sales and Marketing Management**	7.1 Introduction 7.2 Difference between Selling and Marketing 7.3 Functions of Marketing 7.4 Market Survey 7.5 Sales promotions 7.6 Recent trends	**04**
Unit 8	**Safety Engineering**	8.1 Accidents -causes of accidents 8.2 Need for safety 8.3 Organization for safety 8.4 Safety committee 8.5 Safety programs 8.6 Safety measures	**04**
Sub Total: Total Lecture Classes			**45**
No. of classes required for conducting Internal Assessment examination			**06**
Grand Total:			**51**

3. **Course Outcome:** The students of the course should be able to

CO1	Explain the importance of management process in Business.
CO2	Understand different types of organization, Objectives and functions of management.
CO3	Understand the functional areas of management relating human resources, Materials, Finance.
CO4	Apply various rules and regulations concerned with Business & Social Responsibilities of the Technician.
CO5	Identify various components of management.
CO6	Find the economic order quantity (EOQ) for given situation.
CO7	Apply beak even analysis for optimum production.
CO8	Apply principles of safety in industrial activities.

4. Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. Suggested Assignments:

Assignments: (any five)-

1. Preparation of chart for fire safety.
2. Preparation of chart for personal, Tools & Equipment and products safety.
3. Preparation of chart to avoid accident.
4. Preparation of chart to show the different financial ratios.
5. Preparation of chart to show the different types of organization.
6. Preparation of EOQ model.
7. Preparation of beak even analysis model.
8. Prepare charts for showing steps of recruitment, training and performance appraisal.

6. Suggested Learning Resources:

Sl. No.	**Title of Book**	**Author**	**Publication**
1.	Industrial Engineering and Management	O.P. Khanna	Dhanpat Rai & Sons
2.	Management Principles, Processes & Practices	A.Bhattaraya & A.Kumar	Oxford University Press
3.	The process of Management	W.H. Newman E.Kirby Warren Andrew R. McGill	Prentice-Hall of India, New Delhi 2004.
4.	Industrial Engineering & Management,	V.Arun Viswanath, Anoop. S. Nair, S.L.Sabu	SCITECH Publication(s) Pvt. Ltd
5.	Industrial Management	Rustom S. Davar	Khanna Publication
6.	Industrial Engg & Management	N V S Raju	Cengage
7.	Industrial Management	Jhamb & Bokil	Everest Publication, Pune

Name of the Course: Diploma in Food Processing Technology	
Category: Open Elective II	**Semester: Sixth**
Code No.: FPTOE304 (3)	**Theory: 100 Marks**
Course Title: Sustainable Development	**Examination Scheme:**
Duration: 17 weeks (Total hours per week = 3)	External Assessment: **60 Marks** (End Semester Examination)
Total lecture class/week: 3 hours	Internal Assessment: **40 Marks**
Credit: 3	[Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. **Objective:** To increase the awareness towards sustainability.
   To recognize and apply the role of technology towards sustainable development.
   To know the method and tools used for sustainability.
   To know about the environmental pollution management act.

2. **Theory Components:**

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Sustainability**	1.1 Sustainability – introduction – concept – application of this concept 1.2 Social, Economic and environmental Sustainability (Concept only) 1.3 Relation between Technology and Sustainable development. 1.4 Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)- 17th goals of sustainable development by UN. (Name and concept). 1.5 REACH (Registration, evaluation, authorization and restriction of chemicals) – Definition – Application – Aim. 1.6 Clean Development Mechanism (CDM) National Action Plan on Climate Change (NAPCC).	**15**

Unit 2	**Environmental Pollution**	2.1. Introduction of environment- basic elements of environment. 2.2. Environmental pollution – Type of Environment pollution (definition and concept). 2.3. Air Pollution and its sources and effects, - reducing process. 2.4. Water pollution and its sources and effect, - reducing process. 2.5. Soil pollution – cause –effect – reducing process. 2.6. Noise pollution – causes –effect- reducing process. 2.7. Radioactive Pollution- cause –effect and controlling mechanism. 2.8. Solid waste and its causes and effect - Zero waste concept and 3 R concepts in solid waste management. 2.9. Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading, carbon foot print, water footprint, legal provisions for environmental protection.	**10**
Unit 3	**Environmental Pollution Management**	3.1. ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA). 3.2. Circular economy, Bio-mimicking, Environment Impact Assessment (EIA). 3.3. Industrial ecology and industrial symbiosis.	**08**
Unit 4	**Non-Conventional Recourse Management**	4.1. Basic concepts of Renewable energy sources. 4.2. Working principle, advantages, disadvantages about solar photovoltaic, solar thermal energy, bio-energy, Fuel cells, Wind energy, hydro energy, geothermal energy, ocean and tidal energy. 4.3. Worldwide and national progress in renewable energy. 4.4. Environmental aspects of renewable energy projects.	**06**
Unit 5	**Sustainability Practices**	5.1. Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings. 5.2. Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport and other sustainable concepts based on technology up gradation.	**06**
Sub Total: Total Lecture Classes			**45**
No. of classes required for conducting Internal Assessment examination			**06**
Grand Total:			**51**

3. **Course Outcome:** The students of the course should be able to

CO1	Recognize the relevance and the concept of sustainability and different world-wide activities on this direction.
CO2	Illuminate the different types of environmental pollutant, their effects and their sustainable solutions
CO3	Discuss the environmental regulations act. and standards
CO4	Gather basic idea about conventional and non-conventional energy resources
CO5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

4. **Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)**

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. **Suggested Learning Resources:**

Text Books:

i. M.C. Dash, Concepts of Environmental Management for Sustainable Development, Dreamtech Press
ii. Deb Prasanna Choudhury, Sustainability Management, Zorba Books

Reference Books:

iii. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
iv. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
v. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
vi. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
vii. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
viii. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
ix. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
x. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Name of the Course: Diploma in Food Processing Technology	
Category: Open Elective II	**Semester: Sixth**
Code No.: FPTOE304 (4)	**Theory: 100 Marks**
Course Title: Renewable Energy	**Examination Scheme:**
Duration: 17 weeks (Total hours per week = 3)	External Assessment: **60 Marks** (End Semester Examination)
Total lecture class/week: 3 hours	Internal Assessment: **40 Marks**
Credit: 3	[Class test: 20 Marks Home assignments: 10 Marks Class attendance: 10 Marks]
Pass Criterion: Students have to obtain at least 40% marks (**pass marks**) in both internal assessment and end semester examination separately.	

1. **Objective:** To provide basic knowledge of different sources of renewable energy and Renewable energy plants.

2. **Theory Components:**

Unit	Unit Name	Topics and Sub-topics	Teaching Hours
Unit 1	**Introduction**	1.1 Classification of energy: Primary and secondary energy, Commercial and non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy. 1.2 Advantage of Renewable energy 1.3 Sources of Renewable Energy: Solar Energy, Wind Energy, Biomass Energy, Hydro Energy, Geothermal Energy, Tidel and Ocean energy (only brief idea on all these)	**06**
Unit 2	**Solar Energy**	2.1 Units of solar power and solar energy 2.2 Essential subsystem in solar energy plant: Solar collector or concentrator, energy transport medium, energy storage, energy conversion plant, power conditioning control and protection system, alternative or standby power supply. 2.3 Solar Electric System: Solar water Heater, Solar lighting system, Solar cooker, Electric vehicle charging station (Working principle only) 2.4 Idea on Photovoltaic Technology	**09**

Unit 3	**Bioenergy**	3.1 Introduction on Biogas, Sources of Bioenergy 3.2 Different forms of Biomass, their composition & fuel properties 3.3 Production of Biogas: working principle of fixed- dome type and floating gas holder type biogas plant 3.4 Idea of gasifier, digester 3.5 Use of Biogas	**09**
Unit 4	**Wind Energy**	4.1 Basic working principle of Wind energy production 4.2 Speed and power relation, Average power of the wind 4.3 System components of wind Energy (e.g. Tower, Turbine, Blades etc). 4.4 Control of rotor speed	**06**
Unit 5	**Hydropower**	5.1 How hydropower plant works 5.2 Main components of Hydropower plant: Gate, penstock, surge tank, turbine, transformer etc. 5.3 Types of hydropower: Run-of-River power plant (no active storage), Plant with significance storage, Pumped storage, Tidal plant (Only basic idea)	**05**
Unit 6	**Measuring Instruments**	6.1 Basic principle of Pyranometer for solar radiation measurement. 6.2 Idea on different instrument used in Hydroelectric power plant, Solar thermal plant, Wind power plant, Biogas plant (name of instruments and where to use in that plant.)	**10**
Sub Total: Total Lecture Classes			**45**
No. of classes required for conducting Internal Assessment examination			**06**
Grand Total:			**51**

3. **Course outcome:** The students of the course should be able to

CO1	Classify different energy sources.
CO2	Understand basics on solar energy, bioenergy, wind energy, and hydropower.
CO3	Identify different parts of solar energy plant.
CO4	Know various sources of biomass, and construction of biogas production plant.
CO5	Understand concepts of wind energy, components and functions of it.
CO6	Grow critical thinking and problem-solving skills to overcome obstacles to use renewable energy system.
CO7	Identify different measuring instruments related to specific renewable energy plant.

4. **Suggested scheme for question paper design for conducting internal assessment: (Full Marks = 20)**

Questions to be set as per Bloom's Taxonomy				
	Distribution of internal questions			
	Level 1 (Remember)	Level 2 (understand)	Level 3 (Apply & above)	**Total**
Class Test - 1				**20**
Class Test - 2				**20**

5. **Suggested Learning Resources:**

Title	**Author**	**Publisher**
Non-Conventional Energy	Shobh Nath Singh	Pearson
Renewable and Efficient Electric Power Systems	Gilbert M. Masters	Wiley
Alternative Energy Systems & Applications	B.K.Hodge	Wiley
Renewable Energy Technologies,	J.C.Sabonnadiere,	Wiley
Introduction to Renewable Energy	Vaughn Nelson	CRC Press
Renewable Energy: Power for a Sustainable Future	Godfrey Boyle	
Renewable Energy Technology	Jha, Sen, Tiwari, Kothari	New Age International
Renewable Energy Technology	Chetan Singh Solanki	PHI
Non-Conventional Energy Resources	S.H.Saeed, D.K.Sharma	S.K.Kataria& Sons
Energy Techonology: Nonconventional, Renewable & conventional	Rao, Parulekar	Khanna Publisher
Non-conventional Energy Sources	G.D. Rai	Khanna Publisher
Non-Conventional Energy Resources	B. H. Khan	McGraw Hill Publications.
Solar Energy – Principles of Thermal Collection and Storage	S. P. Sukhatme, J.K. Nayak	Tata McGraw-Hill, New Delhi
Solar Energy, Fundamentals and Applications	Garg, Prakash	Pearson

<table>
<tr><td colspan="2">Name of the Course: Diploma in Food Processing Technology</td></tr>
<tr><td>Category: Program Core</td><td>Semester: Sixth</td></tr>
<tr><td>Code No.: FPTPC 306</td><td>Total Marks: 100</td></tr>
<tr><td>Course Title: Food Industry Waste Management Lab.</td><td rowspan="4">Examination Scheme:
Internal Assessment: 60 marks
[Continuous Evaluation: 50 marks
Class Attendance: 10 marks]

External Assessment: 40 Marks (End Semester Examination)
[Assignment on the day of viva voce
and practical report submission: 20 marks
Viva voce (Board of External Examiner): 20 marks]</td></tr>
<tr><td>Duration: 17 weeks (3 hours per week)</td></tr>
<tr><td>Total Practical Class /week: 3 hours</td></tr>
<tr><td>Credit: 1.5</td></tr>
<tr><td colspan="2">Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.</td></tr>
<tr><td colspan="2">Pre-requisite:
Knowledge in Food Industry Waste Management [Code No. – FPTPC304]</td></tr>
</table>

1. Objective:

To provide knowledge of Food Processing Industry Waste Management.
To provide knowledge of the various aspects and methods adopted for Waste Management.
To provide knowledge regarding testing of various wastewater parameters.

2. Practical Components: (At least conduct 09 experiments excluding site visit)

Sl. No.	List of Practical
1.	Familiarization with equipments for wastewater sample collation and analysis.
2.	Determination of physical parameters of waste water Temperature, Colour, Odour, pH.
3.	Determination of total solids , volatile solids and fixed solids of waste water.
4.	Determination of Total Kjeldhal Nitrogen (TKN) from waste water.
5.	Determination of total phosphorus from wastewater.
6.	Determination of electrical conductivity and turbidity of wastewater.
7.	Determination of quality of lime or alum used as a coagulant by Jar test.

8.	Determination of chlorides and sulphates of wastewater.
9.	Determination of phosphorus from wastewater
10.	Determination of acidity and alkalinity of wastewater.
11.	Determination of dissolved oxygen from wastewater.
12.	Determination of biological oxygen demand (BOD) of wastewater.
13.	Determination of chemical oxygen demand (COD) of wastewater.
14.	Determination of oil and grease from wastewater.
15.	Determination of faecal contamination of water- qualitative and quantitative.
16.	16.1 Visit to Composting sites. 16.2 Visit to Vermiculture sites. 16.3 Visit to sewage treatment plants. 16.4 Visit to Common effluent treatment plants. 16.5 Visit to effluent treatment plants of- Sugar industries. 16.6 Visit to effluent treatment plants of- Fruit and vegetable processing industries. 16.7 Visit to effluent treatment plants of- Distillary industries. 16.8 Visit to effluent treatment plants of- Dairy industries. 16.9 Visit to effluent treatment plants of- Fish, meat industries and slaughter houses. 16.10 Visit to effluent treatment plants of-Soft drinks beverage industries.

3. Course outcome: The students of the course should be able to

CO1: Apply the principles of analysis of various wastewater parameters.
CO2: Demonstrate equipments used for wastewater sample collation and analysis.
CO3: Develop ideas on different types of effluent treatment plants and Composting area through site visit.

4. Suggested Scheme for Internal Assessment and End Semester Examination: (Full Marks = 100)

Food Industry Waste Management Lab.			
Practical / Sessional = 100 Marks			
Internal Assessment = 60 Marks		**End Semester Assessment = 40 Marks**	
Continuous Evaluation [Assignments in practical Classes = 30 Marks Class Performance = 20 Marks]	50	Assignment on the day of viva- voce and practical repot submission.	20
Class Attendance	10	Viva voce (Board of External Examiner)	20
Total	**60**	**Total**	**40**

5. Suggested Rubrics for the Internal Continuous Evaluation of Food Industry Waste Management Lab. [50 marks]:

Sl No.	Performance Indicators/ Criteria
1	Awareness about the significance of particular experiment.
2	Understanding working principle of equipment and instruments.
3	Preparation of reagents and experimental set up.
4	Performance and operation.
5	Observations and recording.
6	Interpretation of result and conclusion.
7	Answer to sample questions.
8	Submission of report in time.
9	Safety precautions and good housekeeping.
10	Idea on effluent treatment plants and Composting site.

Name of the Course: Diploma in Food Processing Technology	
Category: Major Project	**Semester: Sixth**
Code No.: FPTPR302	**Total Marks: 100**
Course Title: Major Project-II **Duration: 17 weeks** (3 hours per week) **Total Practical Class /week: 3 hours** **Credit: 1.5**	**Examination Scheme:** Internal Assessment: **60 marks** [Continuous assessment of performance, contribution and in time submission of reports on major projects: 30 Marks Seminar Presentation and Viva Voce: 20 Marks Class Attendance:10 Marks] External Assessment: **40 Marks** (End Semester Examination) [Evaluation of Major Project Reports: 20 marks Viva voce (Board of External Examiner): 20 marks]
Pass Criterion: Students have to obtain at least 40% marks (pass marks) in both internal assessment and end semester examination separately.	
Pre-requisite: Basic Knowledge in Semester-3, Semester-4, Semester- 5 and Semester-6 Subjects.	

1. **Objective:** To have overall grasp on engineering principles in the area of food science, technology, and allied areas. To have knowledge and skills to apply these principles in practical problem-solving in food technology and relevant fields. Ability to verbally communicate with professional organizations and scientific community with reasonable clarity on topics within food science, engineering, technology, and allied areas. Ability to correlate the skills and knowledge acquired over the diploma program with a particular job function as a professional. Ability to handle exposure to professional responsibilities with appropriate level of accountability

2. **Course Outcomes:**

In order to cultivate the systematic methodology for problem solving using acquired technical knowledge and skills, the student should be able to demonstrate the following course outcomes:

CO1: Identify and analyze the problem statement.

CO2: Develop and design alternative solutions for the identified problem.

CO3: Compare and select feasible solutions from alternatives generated.

CO4: Interpret on final results.

CO5: Summarize the conclusion to the problem statement.

3. Scheme of Major Projects-II for Continuous Assessment:

Each student shall undertake project work assigned to him/her related to design/R&D /industrial problem solving in the area of food science and technology under the supervision of a faculty member or a group of faculty member. In principle, the design/development of the project work has to be carried out by a group of student(s)/an individual taking advice/guidance from respective supervisor(s) to address the specific problem identified. The work will be allotted at the beginning of the fifth semester specifying the different aspects to be carried out by the student. The duration of major projects should not be less 10 weeks student engagement hours during the course. The project work shall yield outcome based meaningful results. The student will have to maintain dated work diary consisting of individual contribution in assigned major project works. The student will have to submit reports on their assigned major projects to the concern faculty in time and will give a seminar presentation on their assigned **major projects in front of a Board of Internal Examiners of concern department** at the time of end semester internal assessment.

4. Brief Project Outline

1. Brief introduction, objectives & probable outcomes of the projects.
2. Literature survey/secondary search/market survey.
3. Manufacturing/prototyping/designing process/products, optimization of processes and characterization through analytical techniques.
4. Collection and analysis of data through statistical tools.
5. Conclusion of the project and report preparation.
6. Project defense and viva-voce.

5. Suggested Scheme for Internal Assessment: [Total Marks: 60]

Involvement	Total Marks
Continuous assessment of performance, contribution and in time submission of major projects.	30
Seminar Presentation and Viva Voce on to the major projects at the end of the semester.	20
Class attendance.	10
Total Internal Assessment:	**60**
Pass criterion for Internal Assessment = 24 Marks [Minimum]	

6. Suggested Scheme for End Semester Examination: [Total Marks: 40]

Involvement	Total Marks
Evaluation of major project reports on the day of End Semester Exam.	20
Viva Voce on to the major projects on the day of End Semester Exam.	20
Total External Assessment:	**40**
Pass criterion for Internal Assessment = 16 Marks [Minimum]	

7. Rubrics for the Internal Assessment of Major Projects-II:

The 'Process and Product' related skills associated with each major project work are to be assessed according to a suggested sample as given below:

Sl. No.	Performance Indicators
01	Identify and analyze the problem statement.
02	Develop and design alternative solutions for the identified problem.
03	Interpret on final results.
04	Summarize the conclusion to the problem statement.
05	Submission of major projects reports in time.
06	Viva voce

WEST BENGAL STATE COUNCIL OF TECHNICAL & VOCATIONAL EDUCATION AND SKILL DEVELOPMENT
[A Statutory Body under West Bengal Act XXVI of 2013]
(Formerly West Bengal State Council of Technical Education)
"Karigori Bhavan", 4th Floor, Plot No. B/7, Action Area-III, New Town, Rajarhat, Kolkata-700160

Name of the Course: Diploma in Food Processing Technology	
Category: Seminar	**Semester: Sixth**
Code No.: FPTSE 302	**Total Marks: 100**
Course Title: Seminar **Time: 17 weeks (2 hours per week)** **Total Practical Class /week: 2** **Credit: 1**	**Examination Scheme:** **Internal Assessment: 60 marks** **[Seminar Report = 60 marks]** **External Assessment: 40 Marks** **[**Seminar Presentation **= 40** marks] [Students will give a seminar presentation on their assigned seminar topic in front of a Board of Internal Examiners of concern department at the time of end semester internal assessment.]
Pass Criterion: Students have to obtain at least 40% marks **(pass marks)** in internal assessment examination.	
Pre-requisite: • Basic Knowledge in Food Technology subjects.	

1. **Objective:** To provide opportunity for students to present the seminar on general topic related to course content of diploma in food processing technology in front of a technical gathering with the help of different oral. Aural and visual communication.

2. Scheme of Seminar for Continuous Assessment:

Each student shall undertake seminar topic assigned to him/her related to the area of food science and technology under the supervision of a faculty member or a group of faculty member. In principle, the preparation of the seminar has to be carried out by a group of student(s)/an individual taking advice/guidance from respective supervisor(s) to address the specific problem identified. The work will be allotted at the beginning of the sixth semester specifying the different aspects to be carried out by the student. The duration of seminar should not be less 10 weeks student engagement hours during the course. The student will have to submit reports on their assigned seminar topic to the concern faculty in time and will give a seminar presentation on their assigned seminar topic in front of a **Board of Internal Examiners of concern department** at the time of end semester internal assessment.

3. **Criteria of Evaluation of Seminar Report:** The seminar report will be evaluated on the basis of following criteria **(as applicable):**

Sl. No.	Criteria of Evaluation of Seminar Report
1.	Originality.
2.	Adequacy and purposeful write-up.
3.	Organization, format, drawings, sketches, style, picture, diagram, language.
4.	Concepts taught in the course outcome.
5.	Practical applications, relationships with basic theory and concepts taught in the course.
6.	Attendance record, daily progress, quality of the seminar report.

4. **Criteria of Evaluation of Seminar Presentation:** The student will give a seminar based on his/her seminar topic, before an internal committee constituted by the concerned department of the institute. The evaluation will be based on the following criteria **(as applicable):**

Sl. No.	Criteria of Evaluation of Seminar Presentation
1.	Quality of content presented.
2.	Proper planning for presentation.
3.	Effectiveness of presentation.
4.	Depth of knowledge and skills.
5.	Viva voce.