B.Tech. FOOD TECHNOLOGY
TABLE OF CONTENTS

FOREWORD

Food is an essential part of everyone's lives as it gives us the energy and nutrients to grow and develop, be healthy and active, to move, think and learn. The food you consume on a daily basis is the result of extensive food research, a systematic investigation into a variety of foods, their properties and compositions. After the initial stages of research and development comes the mass production of food products using principles of food technology. If you see the world Hunger Map, Hunger exists all over the world. However, the majority of undernourished people live in developing countries like India and the reason is not the lack of food production but the lack of technology for storage and processing of food.

India ranks first in milk production, second in fruits and vegetables production in the worlds. However, it's a global share in international market is just 1%. Only 2% of these commodities are processes into value-added products. Hence, there is a need for maximum commercial utilization of fruits and vegetables and other food commodities to adapt modern production and marketing activities to the requirements of the world market and cater to domestic demand. Over the past few years, the demand has been exponentially increasing due to various socio- economic factors such as increased population and income.

Within the next 50 years, the world's population is expected to rise to over 9 billion which is alarming and so is the problem of availability of safe food. Food Technology makes it possible for the majority of the world's current population of seven billion to have better access to an abundant, diverse food supply that is largely safe, flavourful, nutritious, convenient and economical than ever before.

Food Technology course was started at Vignan's University in the year 2014 to address the above-mentioned problems in food sector.

The very aim of this Food Technology course is to import knowledge and skills related to food processing, preservation, storage and development of innovative food products with the help of advanced technologies leading to sustainable growth of food sector.

R-22 curriculum comprises of:

- *Modular courses with industry support.*
- *Enhanced skills-based courses for improving employment opportunities.*
- *Advanced courses like food plant equipment design, food processing operations, unit operations.*
- *Laboratory sessions embedded into as many courses as possible.*

In R-22 curriculum, every care has been taken to accommodate the knowledge and skills requirements of industry through proper activities for practice. While making the graduates industry ready, it also enables them to be successful in competitive examinations like GATE and engineering services.

Students are offered training in various fields of foo technology such as bakery and confectionery Technology, dairy technology, fruits and vegetable processing technology, beverage technology etc. Curriculum of the B.Tech Food Technology consists of core Food Technology courses, elective courses, some basic courses of science that form the bridge to technology, industry internships and project works. In the new curriculum of R-22, skill-oriented activities are included to enable the students to acquire hands -on experience of technology to make them technocrats, who are better suited for industry requirements. The board of studies consisting eminent personalities along with experienced faculty members of the university have designed the curriculum to offer knowledge and skill of Food Technology on the above-mentioned areas.

External BoS Members:

1. *Dr. Srinivas Maloo, Vice Principal & Associate Professor, Dept of Food Technology, Osmania University.*
2. *Dr. Ch. V. V. Satyanarayana, Professor & Head, Department of Food Engineering, College of Food Science & Technology, Acharya N.G. Ranga, Bapatla.*
3. *Dr. Ashutosh Inamdar, Senior Principal Scientist, CSIR-CFTRI, Mysore.*
4. *Mr. Prashant Bagade, Head, NCML, Hyderabad.*

I thank all the Bos Members, Academic council and University authorities for encouraging and supporting us in designing this innovative curriculum for our students.

Dr. M. Ramesh Naidu
HoD, Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

VISION

To evolve into a Centre of Excellence in Science & Technology through creative and innovative practices in teaching – learning, towards promoting academic achievement and research excellence to produce internationally accepted, competitive and world class professionals who are psychologically strong & emotionally balanced, imbued with social consciousness & ethical values.

MISSION

To provide high quality academic programmes, training activities, research facilities and opportunities supported by continuous industry - institute interaction aimed at promoting employability, entrepreneurship, leadership and research aptitude among students and contribute to the economic and technological development of the region, state and nation

Department of
FOOD TECHNOLOGY

VISION of the department

To create trained, and skilled human resources well versed in engineering aspects of food processing to cater the needs of the rapidly growing food processing sector.

MISSION of the department

M_1: To establish itself as the leader in human resource development for supporting the food processing sector.

M_2: To provide knowledge and skills for better preservation, processing and value addition to agro-products, with the aim of supporting the producers.

M_3: To promote research and development for product and process and assurance of high level of hygiene and safety of processed food..

M_4: To promote food safety laws and regulations for supporting a competitive, modern and safe food market for the consumers.

B.Tech in Food Technology

Program Educational Objectives (PEOs)

Graduates of Food Technology programme should be able to:

PEO1: Graduates will demonstrate professional competency in Food Technology to solve problems in food science, food engineering and processing with environmental, safety and quality concerns.

PEO2: Graduates will emerge as experts in recent techniques and skills which are essential in the field of food technology.

PEO3: Graduates will perform as an individual and member of a team with professional and ethical behavior.

Program Specific Outcomes (PSOs)

Graduates of Food Technology programme should be able to:

PSO1: Implement and integrate the basic knowledge of process engineering and technology in food formulation and new food products for developing commercial products.

PSO2: Develop techniques and tools for new food products/process at laboratory level and mass production.

PSO3: Design time saving and labor saving hygienic food processing equipment for producing quality and safe food products.

Program Outcomes (POs)

Graduates of Food Technology programme should be able to:

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis: Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**.

PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principle member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

R22
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

I Year I Semester

Course Code	Course Title	L	T	P	C
22MT101	Elementary Mathematics	3	2	-	4
22FT101	Food Biochemistry and Nutrition	2	-	2	3
22EE101	Basics of Electrical and Electronics Engineering	2	-	2	3
22FT103	IT Workshop and Food Engineering Products	1	-	4	3
22TP103	Programming in C	2	-	4	4
22EN102	English Proficiency and Communication Skills.	-	-	2	1
	Total	10	2	14	18
22SA101	Physical Fitness, Sports & Games – I	-	-	3	1
22TP101	Constitution of India	-	2	-	1
	Total	10	4	17	20
	Contact Hours	31 Hrs			

I Year II Semester

Course Code	Course Title	L	T	P	C
22MT110	Matrices and Differential Equations	3	2	-	4
22PY101	Applied Physics	2	-	2	3
22ME101	Engineering Graphics	2	-	2	3
22TP104	Basic Coding Competency	-	1	3	2
22EN104	Technical English Communication	2	-	2	3
22EN102	Food Chemistry	3	-	2	4
	Total	**12**	**3**	**11**	**19**
22SA103	Physical Fitness, Sports & Games – II	-	-	3	1
22SA102	Orientation Session	-	-	6	3
	Total	12	3	20	23
	Contact Hours	35 Hrs			

Department Subject is extension of Basic sciences

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

II Year I Semester

Course Code	Course Title	L	T	P	C
22CT201	Environmental Studies	1	1	-	1
22TP201	Data Structures	2	2	2	4
22FT205	Fundamentals of Fluid Mechanics	2	-	2	3
22FT201	Food Microbiology	3	-	2	4
22FT202	Principles of Food Preservation and Processing	3	-	2	4
22FT203	Engineering Thermodynamics	2	2	-	3
-	Department Elective - 1	2	2	-	3
	Total	15	7	8	22
22SA201	Life Skills	-	-	2	1
	NCC / NSS / SAC / E-cell / Student Mentoring/ Social activities/ Publication	-	-	-	1
	Total	15	7	10	24
	Contact Hours	32 Hrs			

II Year II Semester

Course Code	Course Title	L	T	P	C
22TP203	Advanced Coding Competency	-	-	2	1
22TP204	Professional Communication	-	-	2	1
22FT204	Fruits and Vegetables Processing	3	-	2	4
22FT206	Heat and Mass Transfer	2	2	2	4
22MS201	Management Science	2	2	-	3
22ST202	Probability and Statistics	3	2	-	4
-	Open Elective – 1	3	-	-	3
	Total	13	6	8	20
22SA202	Life Skills	-	-	2	1
	Total	13	6	10	21
	Minor / Honours - 1	3	-	2	4
	Total	16	6	12	25
	Total	34 Hrs			

R22 4 YEAR DEGREE PROGRAMME

COURSE STRUCTURE - R22

III Year I Semester

Course Code	Course Title	L	T	P	C
22TP301	Soft Skills Lab	-	-	2	1
22FT301	Cereals, Legumes, Oilseed Process Technology	3	-	2	4
22FT302	Dairy Technology	3	-	2	4
22FT303	Food Processing Operations	2	2	2	4
-	Department Elective – 2	2	2	-	3
-	Open Elective – 2	3	-	-	3
22FT304	Inter-Departmental Project / Course	-	-	2	-
	Total	13	4	10	19
-	Industry interface course (Modular course)	1	-	-	1
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication	-	-	-	1
	Minor / Honours - 2	3	-	2	4
	Total	17	4	12	25
	Contact Hours	33 Hrs			

III Year II Semester

Course Code	Course Title	L	T	P	C
22TP302	Quantitative Aptitude and Logical Reasoning	1	2	-	2
22FT306	Bakery and Confectionery Technology	3	-	2	4
22FT307	Food Packaging	2	-	2	3
-	Department Elective – 3	2	2	-	3
-	Department Elective – 4	2	2	-	3
-	Open Elective – 3	3	-	-	3
22FT308	Inter-Departmental Project / Course	-	-	2	2
	Total	13	6	6	20
	Minor / Honours - 3	3	-	2	4
	Total	16	6	8	24
	Contact Hours	30 Hrs			

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

IV Year I Semester

Course Code	Course Title	L	T	P	C
	Food Plant Layout and Equipment Design	3	2	-	4
	Food Safety and Quality Management	3	2	-	4
-	Department Elective – 5	2	2	-	3
-	Department Elective – 6	2	2	-	3
-	Department Elective – 7	2	2	-	3
-	Department Elective – 8	2	2	-	3
	Total	14	12	-	20
	Minor / Honours – 4	3	-	2	4
	Total	17	12	2	24
	Contact Hours	31 Hrs			

IV Year II Semester

Course Code	Course Title	L	T	P	C
22FT403 / 22FT404	Project Work / Internship	-	2	22	12
	Total				12
	Minor / Honours – 5 (for project)	-	2	6	4
	Total	-	4	28	16

for interaction between Guide and students

R22 4 YEAR DEGREE PROGRAMME

COURSE STRUCTURE - R22

Department Electives

Course Code	Course Title	L	T	P	C
Stream - 1 Food Business Management					
22FT801	Food Business Management and Entrepreneurship Development	2	2	-	3
22FT802	Food Supply Chain Management	2	2	-	3
22FT803	Production and Operations Management	2	2	-	3
22FT804	Project Planning Preparation and Management	2	2	-	3
22FT805	Strategy and Marketing of Food Products	2	2	-	3
Stream - 2 Food Engineering					
22FT806	Bioprocess Engineering	2	2	-	3
22FT807	Engineering Properties of Food Material	2	2	-	3
22FT808	Instrumentation and Process Control	2	2	-	3
22FT809	Maintenance of Food Equipment	2	2	-	3
22FT810	Refrigeration Engineering and Cold Chain	2	2	-	3
22FT811	Biosensor Design and Application	2	2	-	3
Stream - 3 Food Quality and Assurance					
22FT812	Food Quality Assurance and Certification	2	2	-	3
22FT813	Food Toxicology Agrochemical Residues in Food	2	2	-	3
22FT814	Instrumental Methods of Food Analysis	2	-	2	3
22FT815	Sensory Analysis of Food	2	-	2	3
Stream - 4 Food Processing Technology					
22FT816	Beverage Technology	2	-	2	3
22FT817	Emerging Trends in Food Processing	2	2	-	3
22FT818	Extrusion Technology	2	2	-	3
22FT819	Meat, Poultry and Fish Processing Technology	2	0	2	3
22FT820	Post-Harvest Management of Fruits and Vegetables	2	2	-	3
22FT821	Spices and Plantation Crop Process Technology	2	0	2	3
22FT822	Waste Management and By-Product Utilization	2	2	-	3

List of Honor/Specialization Courses

Course Code	Course Title	L	T	P	C
22FT951	Beverage Technology	2	2	2	4
22FT952	Emerging Trends in Food Processing	2	2	2	4
22FT953	Extrusion Technology	2	2	2	4
22FT954	Waste Management and by-Product Utilization	2	2	2	4
22FT955	Project	-	2	6	4

List of Minor Courses

Course Code	Course Title	L	T	P	C
22FT901	Principles of Food Preservation and Processing	3	-	2	4
22FT902	Fruits and Vegetables Processing	3	-	2	4
22FT903	Dairy Technology	3	-	2	4
22FT904	Bakery and Confectionery Technology	3	-	2	4
22FT905	Food Safety and Quality Management	3	2	-	4

List of Open Elective Courses

I

YEAR

B.Tech.

FOOD TECHNOLOGY

COURSE CONTENTS

I SEM & II SEM

I SEMESTER

22MT101	-	Elementary Mathematics
22FT101	-	Food Biochemistry and Nutrition
22EE101	-	Basics of Electrical and Electronics Engineering
22FT103	-	IT Workshop and Food Engineering Products
22TP103	-	Programming in C
22EN102	-	English Proficiency and Communication Skills
22SA101	-	Physical Fitness , Sports & Games-I
22TP101	-	Constitution of India

II SEMESTER

22MT110	-	Matrices and Differential Equations
22PY101	-	Applied Physics
22ME101	-	Engineering Graphics
22TP104	-	Basic Coding Competency
22EN104	-	Technical English Communication
22FT102	-	Food Chemistry
22SA103	-	Physical Fitness, Sports & Games – II
22SA102	-	Orientation Session

22MT101 ELEMENTARY MATHEMATICS

Hours Per Week :

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: Basics of Geometry and Algebra .

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to make student acquainted with preliminary concepts of mathematics that are useful for their engineering study. Students will learn concepts of progression, partial fractions, straight line, trigonometry, calculus which will help them to apply in various aspects of engineering fields.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

MATHEMATICAL PRELIMINARIES:

Partial fractions, Arithmetic progressions, Geometric progressions

UNIT-2 **12L+8T+0P=20 Hours**

STRAIGHT LINES AND TRIGONOMETRIC RATIOS:

Straight lines: Point in coordinate plane, distance formula, straight line, slope, equation of straight in different forms.

Trigonometric ratios: Trigonometric ratios, Values in different quadrants, Compound angels, Multiple angles.

PRACTICES:

- Splitting a given improper fraction
- Finding the general term and sum of infinite terms of a progression.
- Finding equation of a straight line in various form
- Find the tangent and normal.
- Evaluation of trigonometric function.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

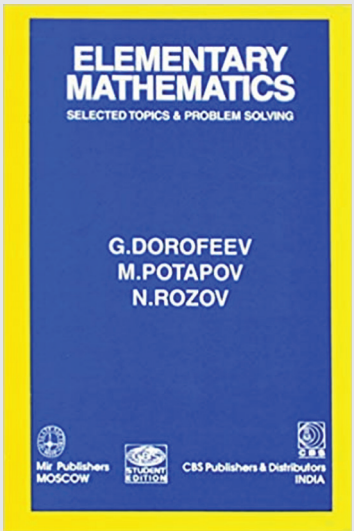
CALCULUS:

Differential Calculus: Introduction to differentiation, Derivatives of simple functions, Product rule, Quotient rule and Chain rule of differentiation.

Integral calculus:
Integration as anti-derivative process, Standard forms, Methods of integration: by substitution, by parts, and by partial fractions, Definite integration.

UNIT-2 **9L+6T+0P=15 Hours**

APPLICATIONS OF CALCULUS:
Tangent, normal, velocity and acceleration.
Evaluation of length and area by integration.



Source : https://www.amazon.in/Elementary-Mathematics-G-Dorofeev/dp/8123908423/ref=sr_1_3?crid=1N1QBXQPFWH7Q&keywords=elementary+mathematics&qid=1661240301&s=books&sprefix=elementary+mathematics%2Cstripbooks%2C210&sr=1-3

SKILLS:

- ✓ *Focusing on Trigonometric Ideas.*
- ✓ *Know the various trigonometric functions.*
- ✓ *Understanding the Applications of Trigonometry and straight lines.*
- ✓ *Understand basic applications of calculus.*

PRACTICES:

- To calculate the profit and loss in business using graphs.
- To check the temperature variation.
- To determine the speed or distance covered.
- Derivatives and integration are used to derive many equations in Physics.
- In the study of Seismology like to find the range of magnitudes of the earthquake

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of straight line in real life problems.	Apply	1	1, 2, 9, 10, 12
2	Apply the concepts of calculus in real life problem	Apply	2	1, 2, 9, 10, 12
3	Distinguish between finite and infinite AP and determine the general term.	Analyze	1	1, 2, 9, 10, 12
4	Categorize right angle triangles to evaluate the trigonometric ratios.	Analyze	2	1, 2, 9, 10, 12

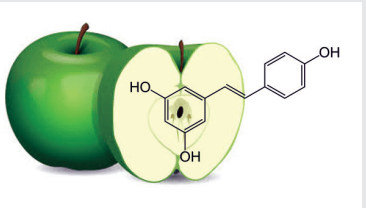
TEXT BOOKS:

1. John Bird, “Higher Engineering Mathematics”, 2nd edition, Routledge (Taylor & Francis Group), London, New York, 2018.
2. Veerarajan, T., “Engineering Mathematics”, 3rd edition, Tata McGraw Hill Publishing Co., New Delhi,2019.

REFERENCE BOOKS:

1. P. Kandasamy, K. Thilagavathy, K.Gunavathy, “Engineering Mathematics”, revised edition, S.Chand& Co., New Delhi,2017.
2. P. Seshagiri Rao, “A Text Book of Remedial Mathematics”, 3rd edition, PharmaMed Press / BSP Books, 2018.
3. Nabjyoti Dutta, BulendraLimboo, BismeetaBuragohain, PranjalTalukdar, “A Basic Course in Mathematics for Polytechnic Vol.1, Vol.2”,2nd Edition, Mahaveer Publications,2017.

22FT101 FOOD BIOCHEMISTRY AND NUTRITION



Source : : https://foodtechpathshala.com/science-of-enzymatic-browning-in-fruits-and-vegetables/

Hours Per Week :

L	T	P	C
2	-	2	3

PREREQUISITE KNOWLEDGE: Chemistry, Biology, Nutrition, Food.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the student's knowledge on biological basis of nutrition, metabolic pathways, enzyme activity and mechanisms by which diet can influence health. The objective of this course is to empower the students with methods and techniques for molecular weight estimation of proteins, qualitative analysis of edible fats and oils and make nutrient profiles for balanced diet and health.

MODULE-1

UNIT-1 **12L+0T+0P=12 Hours**

BASICS OF BIOCHEMISTRY AND NUTRITION:

Scope and history of Food Biochemistry; Introduction to human nutrition; Nutrients- Classification, functions, properties (physical, chemical and structural) and sources of carbohydrate, protein, lipids, vitamins and minerals; Deficiency disorders of nutrients.

UNIT-2 **4L+0T+16P=20 Hours**

ANALYSIS OF NUTRIENTS:

Analysis of nutrients **-** carbohydrate, protein, lipids, fibers, vitamins, minerals, amino acids, fatty acids; Evaluation of protein quality.

PRACTICES:

- Preparation of standard acids and alkali solutions
- Determination of ash content
- Determination of protein by kjeldhal method
- Determination of fat by Soxhlet method.
- Determination of crude fiber content
- Determination of reducing and non-reducing sugars.

MODULE-2

UNIT-1 **8L+0T+0P=8 Hours**

METABOLISM OF BIOMOLECULES:

Digestion and absorption of nutrients; Metabolic pathways- Glycolysis, Kreb cycle, Electron Transport Chain, Pentose Phosphate Pathway; Energetics in metabolism; Biosynthesis and utilization of Carbohydrate, Protein and Lipids.

UNIT-2 **8L+0T+16P=24 Hours**

PROCESSING OF BIOMOLECULES:

Processing induced changes in carbohydrates, protein, lipids, vitamins and minerals, Bioavailability of nutrients, browning reactions, modification of starches, glycemic index, rancidity, thermal decomposition, chemistry of frying; formulation of diet, Basal Metabolic Rate (BMR), assessment of nutritional status, RDA for nutrients for various group.

SKILLS:

- ✓ *Analyze the chemical composition of food materials like moisture, ash, carbohydrate, fat, proteins and fibers.*
- ✓ *Choose the appropriate methods for food analysis*
- ✓ *Apply standards practices in food testing laboratory*
- ✓ *Analyze the nutritional quality of food materials*
- ✓ *Design the desired diet as per requirement of specific groups*

PRACTICES:

- Glucose estimation by DNSA Method.
- Determination of ascorbic acid by dye methods.
- Characterization of oils (Iodine value, Peroxide value, saponification value, Acid value)
- Calculation of Basal Metabolic Rate (BMR)
- Preparation of diet chart

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify and analyse the basic nutrients in food samples	Apply	1	1, 2, 4, 5,6,7, 12
2	Investigate the mechanism of carbohydrate, protein and lipids in cellular system .	Apply	2	1, 2, 3, 4, 5, 6,7, 8,12
3	Analyse properties and importance of nutrients	Analyze	1, 2	1, 2, 3, 4, 6, 7, 8, 9
4	Inspect the food materials for quality and quantity	Analyze	1	1, 2, 5, 9, 10, 12
5	Identify and design the nutritional diet to ensure nu-tritional security for healthy, diseased, sports per-sonnel, pregnant women and elderly person	Evaluate	1, 2	1, 2, 3, 4, 5, 6, 8, 9, 11, 12

TEXT BOOKS:

1. David L Nelson and Michael M Cox, “Lehninger Principles of Biochemistry,” 8th edition, W H Freeman & Co, 2021
2. R.F. Boyer, “Modern Experimental Biochemistry,” 3rd edition, Oxford University Press, 2014

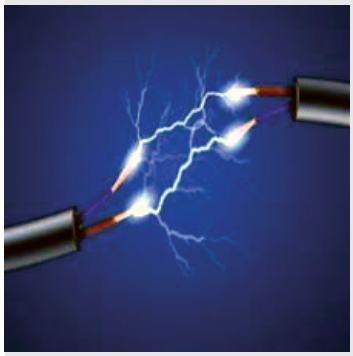
REFERENCE BOOKS:

1. J. L. Jain, Sunjay Jain and Nitin Jain “Fundamentals of Biochemistry”, 6th edition, S Chand and Co. Ltd, Ram Nagar, New Delhi, 2005.
2. Tom Brody “Nutritional Biochemistry”, 2nd Edition, Academic Press. 1999
3. N.A. Michael Eskin and Fereidoon Shahidi “Biochemistry of Food” 3rd Edition, Academic Press. 2012.

22EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Hours Per Week :

L	T	P	C
2	-	2	3



Source : https://vita.vision.org.in/emerging-technologies-in-electrical-engineering/

PREREQUISITE KNOWLEDGE: Electrostatics and Electromagnetism.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an insight into the functioning of basic electrical components like resistor, inductor and capacitor. It deals with the constructional and operational details of AC machines. It also deals with the basic electronic components like P-N junction diode, Zener diode, Transistor and their characteristics.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

FUNDAMENTALS OF ELECTRIC CIRCUITS:

DC Circuits: Concept of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Ohm's Law, Kirchhoff's Laws, Application to simple series, Parallel circuits, Mesh and nodal analysis of resistive circuits with DC source.

AC circuits: Generation of AC voltage, Frequency, Average value, R.M.S. value, Form factor, Peak factor for sinusoidal only.

UNIT-2 **8L+0T+8P=16 Hours**

SEMICONDUCTOR DEVICES:

Classification of semiconductors, P-N junction diode -operation and its characteristics, Half wave rectifier - operation, efficiency; Full wave rectifiers -types, operation, efficiency; Zener diode and its characteristics, Zener diode as Voltage regulator.

Bi polar junction transistor- operation, types (NPN & PNP)

PRACTICES:

- Verification of Ohm's law.
- Verification of Kirchhoff's current law.
- Verification of Kirchhoff's voltage law.
- Determination of R.M.S. Values of sinusoidal waveform.
- Verification of PN junction diode characteristics under both forward and reverse bias.
- Verification of Zener diode characteristics under reverse bias.

MODULE–2

UNIT-1 **8L+0T+8P=16 Hours**

ANALYSIS OF AC CIRCUITS:

Analysis of single- phase ac circuits consisting of R, L, C, RL, RC (series and parallel) (simple numerical problems). Introduction to three phase system, Relation between phase and line quantities of voltages and currents in star and delta connected systems (Elementary treatment only).

SKILLS:

- ✓ *Distinguish between linear and nonlinear elements by looking at VI characteristics.*
- ✓ *Develop a simple loop generator.*
- ✓ *Design a voltage regulator using Zener diode.*
- ✓ *Design a half wave rectifier using PN junction diode.*
- ✓ *Design a full wave rectifier using PN junction diodes.*

UNIT-2 **8L+0T+8P=16 Hours**

AC MACHINES:

Electromagnetism: Concepts of Magneto motive force, Reluctance, Flux and flux density, Concept of self-inductance and mutual inductance, Coefficient of coupling.

Static & Rotating AC Machine: Principle of operation of single phase transformer, Constructional features, EMF equation (simple numerical problems).

Rotating AC Machine: Principle of operation of three phase induction motor, Slip ring and squirrel cage motors, Torque equation; Constructional details of synchronous machine.

PRACTICES:

- Transformation ratio of a single phase transformer at different loads.
- Measurement of Energy in single phase resistive load circuit.
- Measurement of Power in single phase resistive load circuit
- Determination of impedance in complex AC circuits.
- Verification of line and phase quantities in a balanced three phase system.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the resistive circuits with independent sources and find its solution.	Analyze	1,2	1,2,6,9
2	Solve the AC (single and three phase) and DC circuits using different methods.	Apply	1,2	1,2,9,12
3	Apply the concepts of electromagnetism for its applications.	Apply	2	1,2,3,9,12
4	Examine the different electrical equipment.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of semiconductor de-vices to create circuits.	Create	1	1,2,3,9,12

TEXT BOOKS:

1. V. K. Mehta, “Principles of Electrical Engineering and Electronics”, S.Chand& Co., Publications, New Delhi, 2019.
2. D.P. Kothari, “Basic Electrical and Electronics Engineering”, TMH, New Delhi, 2017.

REFERENCE BOOKS:

1. Millman and Halkias, “Electronic Devices and Circuits”, Mc Graw Hill, 2006.
2. A.K. Thereja and B.L.Thereja, “Electrical Technology”, Vol.–II, S. Chand & Co., Publications, 2020.
3. U. Bakshi and A. Bakshi, “Basic Electrical Engineering”, 1st edition, Technical Publications, Pune, Nov 2020.

22FT103 IT WORKSHOP AND FOOD ENGINEERING PRODUCTS

https://www.kent.co.in/cooking-appliances/

Hours Per Week :

L	T	P	C
1	-	4	3

PREREQUISITE KNOWLEDGE: Chemistry, Biology, Nutrition, Food.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with different IT tools and basic food engineering tools. The objective of this course is giving hands on practice on assembling and disassembling, productivity tools like Latex, word, spreadsheets and presentations and to develop models using Carpentry, Fitting, Tinsmith, House wiring.

MODULE - 1

UNIT-1 **5L+0T+10P=15 Hours**

IT WORKSHOP:

Computer Hardware: peripherals of a computer, components in a CPU and its functions, block diagram of the CPU

Tools for Report writing and Presentation: Overview and Installation of Microsoft Word, Excel and PowerPoint Presentation

UNIT-2 **3L+0T+22P=25 Hours.**

Computer Hardware: Disassemble and Assemble the PC back to working condition

Tools for Report writing and Presentation: Creating project, creating a Newsletter using Microsoft Word and LaTeX.

Creating a Scheduler, Calculating GPA, Performance Analysis, Conditional Formatting, Charts and Pivot Tables using MS Excel; Power Point utilities and tools, Master Layouts, Design Templates, Background and textures using Power Point Presentation.

PRACTICES:

- Troubleshooting of a computer Hardware
- Assembly and Disassembly of a Computer
- Creation of projects and Newsletter using MS Word and LaTeX
- Spreadsheet basics, modifying worksheets, formatting cells, formulas and functions, sorting and filtering, charts using MS Excel
- Power point screen, working with slides, add content, work with text, working with tables, graphics, slide animation, reordering slides, adding sound to a presentation using MS PPT.

MODULE - 2

UNIT-1 **6L+0T+10P=16 Hours.**

BASIC ENGINEERING:

Engineering Materials: Introduction, Classification, Ferrous & non-ferrous metals and alloys

Trades: Introduction and Materials used in Carpentry, Fitting, Tin smithy and House Wiring. Cutting Tools, Holding Tools, Marking Tools used and types of joints made in Carpentry, Fitting, Tin smithy and House Wiring.

SKILLS:

- ✓ *Design and develop various sheet metal products.*
- ✓ *Analyze the functioning & troubleshoots of household appliances.*
- ✓ *Create products by using different trades for Industrial applications.*

UNIT-2 **2L+0T+22P=24 Hours.**

FOOD ENGINEERING PRODUCTS:

Working principles, Parts and Applications of Basic Food Engineering products: Air Conditioner, Refrigerator, Pumps, Microwave Oven, Pressure Cooker/Electrical Cooker, Grinder-Mixer, Water Purifiers, Induction, Fruits and vegetable washer/sanitizer, Sealing Machine, Electrical Kettle.

PRACTICES:

- Fabrication of T-lap joint using carpentry tools.
- Fabrication of V-fit using fitting tools.
- Fabrication of truncated cylinder using tin smith tools.
- Demonstration of modelling & functioning of air-conditioners.
- Demonstration of modelling & functioning of refrigerators.
- Preparation of bakery products using microwave oven.
- Preservation of fruits and vegetables by using refrigerator
- Preparation of chutneys/spice powders using mixer-grinder
- Preparation of Maggi/Tea/Coffee/Hot drinks using electric kettle
- Cooking of food materials using home cooking appliances.
- Packaging of food products in different packaging materials

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Assemble and disassemble of a computer	Apply	1	1, 2, 4, 5,6,7, 12
2	Create documents, spread sheets and presentations using LaTeX and MS Tools	Apply	2	1, 2, 3, 4, 5, 6,7, 8,12
3	Fabricate different models using workshop trades.	Analyze	1, 2	1, 2, 3, 4, 6, 7, 8, 9
4	Develop methodology for fabrication as per specifi-cations of the product.	Analyze	1	1, 2, 5, 9, 10, 12
5.	Analyse the functioning of home appliances	Evaluate	1, 2	1, 2, 3, 4, 5, 6, 8, 9, 11, 12

TEXT BOOKS:

1. Peter Norton, “Introduction to Computers”, Tata Mc Graw Hill Publishers, 7th Edition, 2017.
2. Felix W “Basic Workshop Technology: Manufacturing Process”, 1st Edition, 2019.

REFERENCES:

1. K.V.N.Pakirappa, “Workshop Technology”, 5 th edition, Radiant Publishing House, 2011.
2. T.V.Gopal, T.Kumar and G. Murali, “A first Course on Workshop Practice: Theory, Practice and Work Book”, Suma Publication, 2005.
3. S.K Hazra Choudhury, “Elements of Work Shop Technology”, 11th edition, Media Promoters, 1997.

22TP103 PROGRAMMING IN C

✓ *Source: https://www.techgig.com/*

Hours Per Week :

L	T	P	C
2	-	4	4

PREREQUISITE KNOWLEDGE: Fundamentals of Problem Solving.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on basic concepts of C programming language and problem solving through programming. It covers basic structure of C program, data types, operators, decision making statements, loops, functions, strings, pointers, and also file manipulations. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE- 1

UNIT-1 **8L+0T+16P=24 Hours**

INTRODUCTION TO ALGORITHMS AND PROGRAMMING LANGUAGES:

Introduction to Algorithms: Basics of algorithms; Flow charts; Generations of programming languages. Introduction to C: Structure of a C program - pre-processor statement, inline comments, variable declaration statements, executable statements; C Tokens - C character set, identifiers and keywords, type qualifiers, type modifiers, variables, constants, punctuations and operators.

Data Types and Operators: Basic data types; Storage classes; Scope of a variable; Formatted I/O; Reading and writing characters; Operators - assignment, arithmetic, relational, logical, bitwise, ternary, address, indirection, sizeof, dot, arrow, parentheses operators; Expressions - operator precedence, associative rules.

Control Statements: Introduction to category of control statements; Conditional branching statements - if, if– else, nested-if, if – else ladder, switch case; Iterative statements - for, while, do - while, nested loops; Jump statements - break, jump, goto and continue.

UNIT-2 **8L+0T+16P=24 Hours**

ARRAYS & STRINGS:

Arrays: Introduction; Types of arrays; Single dimensional array - declaration, initialization, usage, reading, writing, accessing, memory representation, operations; Multidimensional arrays.

Strings: Character array, Reading string from the standard input device, Displaying strings on the standard output device, Importance of terminating a string, Standard string library functions.

PRACTICES:

Questions on Data Handling – Level 1:

- Write a program to accept a character as input from the user and print it.
- Write a program to accept a number as input from the user and print it.
- Write a program to accept a float value from the user and print it.
- Write a program to accept a message as input from the user and print it.
- Write a program to accept a message from the user as input and print it in 3 different lines.
- Write a program to accept 2 numbers from the user as input and print their sum.
- Write a program to accept 2 numbers from the user as input and print their product.
- Write a program to accept a number as input from the user which denotes the temperature in Celsius, convert it to Fahrenheit reading and print it.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Select static or dynamic data structures for a given problem and manipulation of data items.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- Write a program to accept a number as input from the user which denotes the radius and print the area of the circle.
- Write a program to accept a character as input from the user and print it's corresponding ASCII value.

Questions on Control Statements - Looping – Level 1:

- Write a C program to print all the characters from a to z once.
- Write a C program to print all the characters from Z to A once.
- Write a C program to print all the characters from A to Z 3 times.
- Write a C program to print the first N natural numbers, where N is given as input by the user.
- Write a C program to print the first N natural numbers and their sum, where N is given as input by the user.
- Write a C program to print all the odd numbers between 1 and N where N is given as input by the user.
- Write a C program to print all the even numbers between I and N where N is given as input by the user.
- Write a C program to print the squares of the first N natural numbers between 1 and N, where N is given as input by the user.
- Write a C program to print the cubes of the first N natural numbers between 1 and N, where N is given as input by the user.
- Write a C program to print the squares of every 5th number starting from 1 to N, where N is given as input by the user.

Questions on Control Statements – Decision Making – Level 1:

- Write a program to accept two numbers as input check if they are equal.
- Write a program to accept two characters as input and check if they are equal.
- Write a program to accept two numbers as input and print the greater of the 2 numbers.
- Write a program to accept two numbers as input and print the lesser of the 2 numbers.
- Write a program to accept 3 numbers as input and print the maximum of the 3.
- Write a program to accept 3 numbers as input and print the minimum of the 3.
- Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
- Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
- Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
- Write a program to accept a number as input and check if it is positive, negative or zero.

Questions on Patterns – Level 1:

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*****
*****
*****
*****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*****
*   *
*   *
*   *
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*
**
***
****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
    *
   **
  ***
 ****
*****
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
12
123
1234
12345
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
22
333
4444
55555
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
54321
4321
321
21
1
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
12345
2345
345
45
5
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
A
AB
ABC
ABCD
ABCDE
```

- Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

  A

  BC

  DEF

  GHIJ

  KLMNO

Questions on Number Crunching – Level 1:

- Write a program to accept a number as input and print the number of digits in the number.
- Write a program to accept a number as input print the sum of its digits.
- Write a program to accept a number as input, reverse the number and print it.
- Write a program to accept a number and digit as input and find the number of occurrences of the digit in the number.
- Write a program to accept a number as input and check if it is an Armstrong number.
- Write a program to accept a number as input and check if it is an Adam number.
- Write a program to accept a number as input and check if is a prime number.
- Write a program to accept 2 numbers as input and check if they are amicable or not.
- Write a program to accept a number as input and check if it is a power of 2.
- Write a program to accept 2 numbers as input and find their LCM.

Questions on Arrays – Level 1:

- Print the contents of an array from the left to the right.
- Print the contents of an array from the right to the left.
- Find the sum of the elements of an array.
- Find the maximum element in an unsorted array.
- Find the minimum element in an unsorted array.
- Find the average of the elements in an unsorted array.
- Count the number of 0s and 1s in an array having 0s and 1s in random order.
- Count the number of elements in an array whose elements are lesser than a key element in an unsorted array.
- Print all the elements in an array whose values are lesser than a key element in an unsorted array.
- Find the repeated elements in a sorted array.

Questions Number crunching – Level 2:

- Write a program to accept a number as input and print the product of its digits.
- Write a program to accept a number as input and check if it is a palindrome.
- Write a program to accept a number as input and print the frequency of occurrence of each digit.
- Write a program to accept a number as input and print its factors.
- Write a program to accept a number as input and print its prime factors.
- Write a program to accept a number as input and check if it is a perfect square of not.
- Write a program to accept 2 numbers as input and check if they are betrothed numbers or not.
- Write a program to accept 2 numbers as input and print their HCF.
- Write a program to accept a number as input and check if is a strong number.
- Write a program to generate prime numbers between two intervals given as input.

Questions on Arrays – Level 2:

- Find the sum of the maximum and minimum numbers of an unsorted array.
- Replace every element in an array with the sum of its every other element.
- Replace every element in an array with the sum of its right side elements.
- Replace every element in an array with the sum of its left side elements.
- Reverse the elements of an array (in place replacement).
- Reverse the first half of an array.

- Reverse the second half of an array.
- Write a program to find the second largest element in an unsorted array.
- Write a program to find the second smallest element in an unsorted array.
- Write a program to print the number of odd and even numbers in an unsorted array.

Questions on Strings – Level 1:

- Write a program to accept a string as input and print it.
- Write a program to accept a string as input and count the number of vowels in it.
- Write a program to accept a string as input and count the number of consonants in it.
- Write a program to accept a string as input and print its length.
- Write a program to accept a string as input and print the reversed string.
- Write a program to accept 2 strings as input and check if they are the same.
- Write a program to accept a string as input and copy the contents into a second string and print the second string.
- Write a program to accept 2 strings as input and concatenate them into a third string and print the third string.
- Write a program to accept a string as input and check if it is a palindrome.
- Write a program to accept two strings as input and check if the second string is a substring of the first.

Questions on Strings – Level 2:

- Implement the string length function.
- Implement the string copy function.
- Implement the string concatenate function.
- Implement the string compare function.
- Implement the vowel count function.
- Implement the consonant count function.
- Implement the count words function.
- Implement the string reverse function.
- Implement the strstr function.
- Complete the code snippet to implement the is Palindrome function that checks if a given string is a palindrome. You will need to use the 3 functions string Copy, str Reverse and string Compare functions provided to accomplish this.

MODULE-2

UNIT-1 **8L+0T+16P=24 Hours**

FUNCTIONS & POINTERS:

User-defined functions: Function declaration - definition, header of a function, body of a function, function invocation; Call by value; Call by address; Passing arrays to functions; Command line arguments; Recursion; Library Functions.

Pointers: Declaration, Initialization, Multiple indirection, Pointer arithmetic, Relationship between arrays and pointers, Scaling up - array of arrays, array of pointers, pointer to a pointer and pointer to an array; Dynamic memory allocation functions.

UNIT- 2 **8L+0T+16P=24 Hours**

STRUCTURES, UNIONS & FILES:

Structures: Defining a structure, Declaring structure variable, Operations on structures, Pointers to structure - declaring pointer to a structure, accessing structure members using pointer; Array of structures, Nested structures, Passing structures to functions - passing each member of a structure as a separate argument, passing structure variable by value, passing structure variable by reference/ address; Typedef and structures.

Unions: Defining a union - declaring union variable, operations on union; Pointers to union - declaring pointer to a union, accessing union members using pointer; Array of union, Nested union, Typedef and union, Enumerations, Bit-fields.

Files: Introduction to files, Streams, I/O using streams – opening a stream, closing stream; Character input, Character output, File position indicator, End of file and errors, Line input and line output, Formatted I/O, Block input and output, File type, Files and command line arguments.

PRACTICES:

Questions on Strings – Level 3:

- Write a program to swap two given strings and print the swapped strings.
- Write a program to swap two given words of the given sentence and print the altered string.
- Return the maximum occurring character in the string.
- Write a program to print the character in the string with the count where count is the occurrence of the character.
- Write a program to print the duplicate characters in the given string.
- Write a program to remove the duplicate characters in the given string.
- Write a program to remove the vowels from a given string.
- Write a program to rotate a given string N number of times.
- Write a program to check if 2 strings are rotations of each other.
- Write a program to remove the characters from the first string that are present in the second string.

Questions on 2D Arrays – Level 1:

- Print the contents of a 2D array row-wise.
- Print the contents of a 2D array column-wise.
- Print the contents of a 2D array in a zig-zag order.
- Print the contents of a 2D array diagonal-wise.
- Print the contents of a 2D array right-diagonal order.
- Print the contents of a 2D array left-diagonal order.
- Print the contents of a 2D array in the upper triangular order – left top to right bottom.
- Print the contents of a 2D array in the lower triangular order.
- Find and print the maximum element along with its position in a matrix.
- Find and print the minimum element along with its position in a matrix.

Questions on 2D Arrays – Level 2:

- Find and print the maximum element of each row of a matrix.
- Find and print the minimum elements of each row of a matrix.
- Find and print the maximum element of each column of a matrix.
- Find and print the minimum element of each column of a matrix.
- Find the lowest value in the upper triangle area and the largest value in the lower triangular area of a matrix and print their product.
- Find the sum of the elements of each row and each column of a matrix and print the minimum row sum and maximum sum column.
- Write a program to find the row with the maximum number of 1’s in a matrix consisting of only 0’s and 1’s.
- Write a program to print the quotient and remainder on dividing sum of left-top to right-bottom diagonal by sum of right-top to left-bottom diagonal.
- Write a program to print the absolute difference of the sum of major diagonal elements and the sum of minor diagonals of the given matrix.
- Write a program to search a given element in a row-wise and column-wise sorted 2D array.

Questions on 2D Arrays – Level 3:

- Write a program to find the Kth smallest element in the given matrix.
- Write a program to find the Kth largest element in the given matrix.

- Write a program to check whether the given two two-dimensional array of same dimensions are equal or not.
- Write a program to add the given two two-dimensional array of same dimensions.
- Write a program to subtract the given two two-dimensional array of same dimensions.
- Write a program to multiply the given two two-dimensional array of same dimensions.
- Write a program to sort each row of a matrix.
- Write a program to find the sum of the elements in 'Z' sequence of the given 2D array.
- Write a program to print the unique rows of the given two-dimensional array consisting of only 0's and 1's.
- Write a program to print the unique columns of the given two-dimensional array consisting of only 0's and 1's.

Questions on Files, Structures & Unions:

- Write a C program to create a struct, named Student, representing the student's details as follows: first_name, last_name, Age and standard.

  Example

  Read student data

  john

  carmack

  15

  10

  Display the data in the following format

  First Name: john

  Last Name: carmack

  Age: 15

  Standard: 10

- Declare a structure POINT. Input the coordinates of point variable and write a C program to determine the quadrant in which it lies. The following table can be used to determine the quadrant.

Quadrant	X	Y
1	Positive	Positive
2	Negative	Positive
3	Negative	Negative
4	Positive	Negative

  Example

  Input the values for X and Y coordinate: 7 9

  The coordinate point (7,9) lies in the First quadrant.

- Bob and Alice both are friends. Bob asked Alice how to store the information of the books using Structures. Then Alice written a c program to store the information of books using book structure by taking different attributes like book_name, author, book_id, price. Write a C program to read and display the attributes of the books using structures.

  Sample Input:

  Enter number of books: 1

  Enter the book name: c Programming

  Enter the author name: balaguruswamy

  Enter the book ID: 23413

  Enter the book price: 500

  Sample Output:

  The details of the book are:

  The book name is: c Programming

The author name is: balaguruswamy

The book ID is: 23413

The book price is: 500.00

- Ramesh wants to do addition on complex numbers. He did it with regular practice but Charan asked him to do with the help of structures by following below Criteria.

  Write a C program that defines a structure named 'Complex' consisting of two floating point members called "real and imaginary". Let c1 and c2 are two Complex variables; compute the sum of two variables.

  Example:

  c1= 2 8
  c2= 6 4
  Sum= 8.000000+12.000000i

- Customer Payment Details is a structure with members as customers_name, address, account_number, payment_status(paid(1)/ not_paid(0)), due_date, and amount. In this example, payment_date is another structure with month, day and year as integer members. So, every customer record can be considered as an array of structures.

  Write a C program that displays the amount to be paid by each customer along with their names. If payment_status is 1, display NIL for such customers.

  Input Format:

  First line of input contains 'n' number of customers, followed by 8 lines of input for each customer. Each line represents (customers_name, address, account_number, amount payment_status(paid(1)/ not_paid(0)), and due_date).

  Output Format:

  First line of output is Amount to be paid by each customer as on date: followed by n lines of output. Each line contains name of the customer followed by tab space, and amount to be paid.

  Hint: Use nested structure to represent date.

  Write a 'C' program to accept customer details such as: Account_no, Name, Balance using structure. Assume 3 customers in the bank. Write a function to print the account no. and name of each customer whose balance < 100 Rs.

- Write a C program to accept details of 'n' employee(eno, ename, salary) and display the details of employee having highest salary. Use array of structure.

- Write a C program to print the bill details of 'N' number of customers with the following data: meter number, customer name, no of units consumed, bill date, last date to deposit and city. The bill is to be calculated according to the following conditions:

No. of units	**Charges**
For first 100 units	Rs.0.75 per unit
For the next 200 units	Rs.1.80 per unit
For the next 200 units	Rs.2.75 per unit

  Sample Input

  Enter no. of customers

  1

  Enter Meter Number AP01213

  Enter Customer Name: Karthik

  Enter No. of units consumed: 200

  Enter Bill date:22/01/2021

  Enter Last date: 12/2/2021

  Enter City: Guntur

  Sample Output

  Meter Number AP01213

  Customer Name: Karthik

No. of units consumed: 200

Bill date:22/01/2021

Last date: 12/2/2021

City: Guntur

Total Amount: 255.000000

- Write a C program that creates a student file containing {Roll No, Student Name, Address, Stream}, where the data will be inserted and display the list of students who are in CSE (Stream=CSE).

  Input: A file name

  Output: The attributes such as Roll_No, Student_Name, Stream, Address.

  Sample Input

201fa4200	Raja	CSE	Guntur
201fa4201	Bala	IT	Tenali

  Sample Output

201fa4200	Raja	CSE	Guntur

- Write a C program that reads content from an existing text file and write the same in a new file by changing all lowercase alphabetic character to upper case. (Existing file may contain digit and special characters).

  Example:

  Input: Enter the file name.

  Output: New file with updated content.

- Write a C program to count the occurrences of the given string in a file.

  Example:

  Input: Enter the File name to read the string to be counted.

  Output: Display the count of occurrences of the string.

- Write a C Program to transfer the data from one location to another location without changing the order of the content.

  Example:

  Read the file name from the user. If the source file exists, Transfer the data and display the message as “Data is transferred successfully” otherwise display the message “No such file is existing in the directory.”

- Write a C program that reads numbers and write them into a text-file. Also find odd and even numbers in that file and store it in 2 separate files named odd.txt and even.txt. All the values should be in ascending order.

  Input: Enter the values.

  Output: Creates a separate file for Even and Odd numbers.

  Sample Input:

  4 43 2 53 45

  Sample Output:

  Even.txt: 2 4

  Odd.txt: 43 45 53

- Write a C program to replace the content in the given text file.

  Input: Enter the file name, line number to be replaced and the new content

  Output: New file with replaced lines.

  Example:

  Sample Input: Enter the file name: abc.txt

  Enter the line no to replace: 3

  Enter the content: Files stores data presently.

Sample Output:

Line no 3 is replaced with the given content.

The content of the file abc.txt contains:

test line 1

test line 2

Files stores data presently

test line 4

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
2.	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
3.	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
4.	Develop C programs that are understandable, debug-gable, maintainable and more likely to work correctly in the first attempt.	Evaluate	1,2	3,4
5.	Design and develop non- recursive and recursive func-tions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, “Programming for Problem Solving”, 1st edition, Cengage publications, 2019.
2. Ajay Mittal, “Programming in C - A Practical Approach”, 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, “Computer Fundamentals and Programming in C”, 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, “Programming with C”, 4th edition, Tata McGraw-Hill, 2018.

22EN102 ENGLISH PROFICIENCY AND COMMUNICATION SKILLS

Hours Per Week :

L	T	P	C
-	-	2	1

PREREQUISITE KNOWLEDGE: Basics of grammar, Read and understand for global context, Cultural sensitivity and Basic writing skills.

COURSE DESCRIPTION AND OBJECTIVES:

English Proficiency and Communication Skills seeks to develop the students' abilities in grammar, speaking, reading, writing and overall comprehension skills. The course will provide students an exposure on a wide range of language use in everyday situations. It will make the students to equip with functional English and make them use it confidently in their professional and social contexts. Finally, students will strengthen their reading, writing, listening and speaking skills in English.

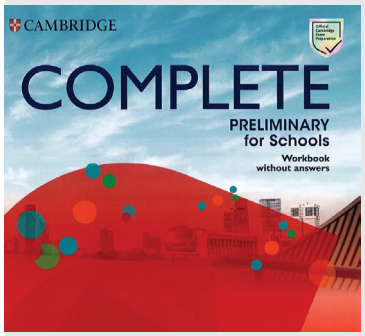


Image source: https://www.scribd.com/document/502301821/Cambridge-Complete-B1-Preliminary-for-Schools-Workbook-2020-Edition

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

MY LIFE AND HOME – MAKING CHOICES – HAVING FUN:

Reading: Understanding main message, factual information global meaning, specific information and paraphrasing.
Writing: Developing hints based mail, Writing short messages/paragraphs.
Listening: Understanding short monologues or dialogues and choose the correct visual.
Speaking: Express simple opinions /cultural matters in a limited way.
Vocabulary: Discerning use of right word suiting the context, B1 Preliminary word list.
Grammar: Frequency Adverbs, State Verbs, AFV and Prepositions.

UNIT-2 **0L+0T+8P=8 Hours**

ON HOLIDAY - DIFFERENT FEELINGS – THAT'S ENTERTAINMENT:

Reading: Longer text for detailed comprehension, gist and inference.
Writing: Developing notes and responding to penfriends or 'e-pals'.
Listening: Understand straightforward instructions or public announcements.
Speaking: Describing people, things and places in a photograph.
Vocabulary/Grammar:
Comparatives and Superlatives, Gradable and non-gradable adjectives, Cloze tests.

PRACTICES:

- Developing hints based mail.
- Writing short message.
- Writing paragraphs.
- Expressing opinions and cultural matters.
- Understanding short monologues.
- Understanding straightforward instructions and public announcements.
- Describing people, things and places in a photograph.

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

GETTING AROUND – INFLUENCES - STAY FIT AND HEALTHY:

Reading: Reading for understanding coherence of the text and drawing inferences.
Writing: Reading an announcement from a magazine or website for preparing an article.

SKILLS:

- ✓ *Use of appropriate grammar and vocabulary with syntactic patterns in short texts.*
- ✓ *Read and extract the main message, global meaning, specific information, detailed comprehension, understanding of attitude, opinion and writer purpose and inference.*
- ✓ *Listen to understand key information, specific information, gist and detailed meaning and to interpret meaning.*
- ✓ *Understand questions and make appropriate responses and talk freely on everyday topics.*

Listening: Discussion activities and listening to understand the gist of each short dialogue.

Speaking: Snap Talks, Make and respond to suggestions, discuss alternatives and negotiate agreement.

Vocabulary / Grammar: Punctuation, Prepositions, Phrasal Verbs, B1 Preliminary word list.

UNIT-2 **0L+0T+8P=8 Hours**

LOOKS AMAZING! – THE NATURAL WORLD – EXPRESS YOURSELF!:

Reading: Content, Communicative Achievement, Organisation and Language.

Writing: Developing a story with clear links to the given opening sentence.

Listening: An interview for a detailed understanding of meaning and to identify attitudes and opinions.

Speaking: Discuss likes, dislikes, experiences, opinions, habits, etc.

Vocabulary/Grammar: Modals, Conditionals, Verb forms (Time and Tense).

PRACTICES:

- Listening to understand the gist of each short dialogue.
- Listening to an interview for a detailed understanding of meaning and to identify attitudes and opinions.
- Preparing an article.
- Discuss for alternatives and negotiate agreement.
- Discussion on likes, dislikes, experiences, opinions, habits, etc.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply to read and grasp content on a range of top-ics/ texts related to their everyday life like notifica-tions, advertisements, travel brochures, news reports, and articles.	Apply	1	7, 8, 9, 10, 12
2	Apply suitable strategies to achieve comprehension, like listening for main points and checking compre-hension using contextual clues etc.	Apply	1	7, 8, 9, 10, 12
3	Demonstrate vocabulary beyond that of the familiar subjects.	Ana-lyze	1, 2	7, 8, 9, 10, 12
4	Show sufficient control of English grammar and sen-tence variety to coherently organise information at sentence and discourse levels.	Evaluate	2	7, 8, 9, 10, 12
5	Use functional English to communicate and interact effectively in everyday situations.	Create	1, 2	7, 8, 9, 10, 12

TEXT BOOKS:

1. Emma Heyderman and Peter May, “Complete Preliminary”, Student’s Book with Answers, 2nd edition, Cambridge University Press, 2019.

REFERENCE BOOKS:

1. Annette Capel and Rosemary Nixon, “Introduction to PET”, Oxford University Press, 2009.
2. Adrian Doff and Craig Thaine, Empower Pre intermediate, Cambridge University Press, 2015.
3. Louise Hashemi and Barbara Thomas, Objective PET, Cambridge University Press, 2010.

22TP101 CONSTITUTION OF INDIA

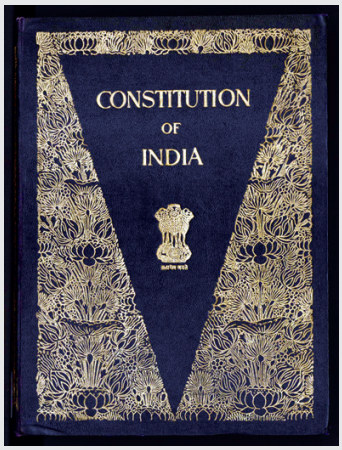


Image: https://commons.wikimedia.org/wiki/File:Constitution_india.jpg

Hours Per Week :

L	T	P	C
-	2	-	1

PREREQUISITE KNOWLEDGE: High School-level Civics and Social Studies.

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with a basic understanding of Indian Polity and Constitution and make students understand the functioning of government at the center and state level besides local self-government. This course also equips students with knowledge pertaining to fundamental rights and fundamental duties of a citizen in a democracy such as India.

MODULE-1

UNIT-1 **0L+8T+0P=8 Hours**

HISTORICAL BACKGROUND TO THE INDIAN CONSTITUTION:

Meaning of the constitution law and constitutionalism; Historical perspective of the Constitution of India; Salient features and characteristics of the Constitution of India.

UNIT-2 **0L+8T+0P=8 Hours**

FUNDAMENTAL RIGHTS, DUTIES, DIRECTIVE PRINCIPLES, AND AMENDMENT:

Scheme of the fundamental rights - scheme of the Fundamental Right to Equality; scheme of the Fundamental Right to certain Freedom under Article 19; scope of the Right to Life and Personal Liberty under Article 21; Scheme of the Fundamental Duties and its legal status; Directive Principles of State Policy – its importance and implementation; Amendment of the Constitution - Powers and Procedure.

PRACTICES:

- Enactment of Constituent Assembly debates to further understand the rationale for the provisions of the constitution.
- Fundamental Rights in our popular culture - discussion in the movie Jai Bhim.

MODULE-2

UNIT-1 **0L+8T+0P=8 Hours**

STRUCTURE AND FORM OF GOVERNMENT:

Federal structure and distribution of legislative and financial powers between the Union and the States; Parliamentary Form of Government in India – The constitution powers and status of the President of India; Emergency Provisions: National Emergency, President Rule, Financial Emergency.

UNIT-2 **0L+8T+0P=8 Hours**

LOCAL SELF GOVERNMENT:

Local Self Government – Constitutional Scheme in India – 73rd and 74th Amendments.

PRACTICES:

- Debate on federalism in India.
- Collect news published in the local papers about panchayats in the nearby areas.

SKILLS:

- ✓ *Understanding the basics of the Indian constitution.*
- ✓ *Know the fundamental rights, fundamental duties, and Directive Principles of State Policy.*
- ✓ *Fair knowledge about the functioning of various institutions in a democracy.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Appreciation for the constitution and safeguarding individual rights.	Apply	1	6
2	Analyse major articles and provisions of the Indian constitution.	Analyze	1	6
3	Evaluating functions of various organs of the State in a democracy.	Evaluate	2	6

TEXTBOOK:

1. PM Bhakshi, “Constitution of India”, 15th edition, Universal Law Publishing, 2018.

REFERENCE BOOKS:

1. B. R. Ambedkar, “The Constitution of India” Educreation Publishing, India, 2020.
2. Subhash Kashyap, “Our Constitution” 2nd edition, National Book Trust, India, 2011.
3. Arun K. Thiruvengadam, “The Constitution of India: A Contextual Analysis”, Hart Publishing India, 2017.

22MT110 MATRICES AND DIFFERENTIAL EQUATIONS

Hours Per Week :

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: School level Mathematics, Differentiation and Integration.

COURSE DESCRIPTION AND OBJECTIVES:

This course will help the students to learn the concepts of matrices and differential equations. Also they can apply these concepts in any engineering and science domains.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

MATRICES:

Definition of matrix; Types of matrices; Algebra of matrices, adjoint of a matrix, inverse of a matrix by elementary operations, Rank of a matrix, Echelon form, Normal form.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF MATRICES:

Consistency of system of linear equations, Solution of system of linear equations by Gauss elimination method and Gauss Jordan method.

Eigen values and Eigen vectors (up to 3 x 3 matrices only) and properties (without proofs).

PRACTICES:

- Identify the matrix and do various operations on it.
- Finding rank of matrix.
- Solving a system of equation using matrix method
- Find Eigen values and Eigen vectors

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

ORDINARY DIFFERENTIAL EQUATIONS:

First Order Differential Equations: Introduction to ODE, variable separable method, homogenous and non-homogenous differential equations, linear differential equations, Bernoulli's equations.

Second Order Differential Equations: Linear Homogeneous and non-homogeneous differential equations with constant coefficients (RHS is eax, xn, sin(ax) or cos(ax)).

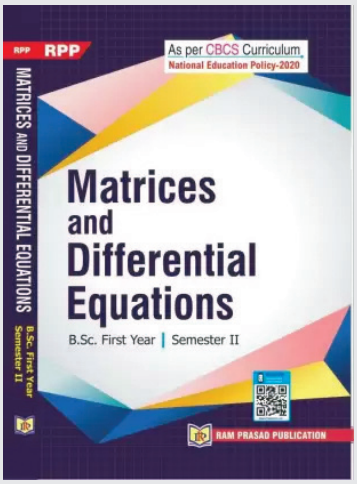
UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF ODE:

Applications of ODE: Newton's law of cooling, Law of natural growth and decay, LC circuit.

PRACTICES:

- Finding Solutions of Differential Equations.
- Apply the concepts of Differential equations.



Source : https://www.flipkart.com/matrices-differential-equations-nep-b-sc-sem-ii/p/itmefb5ea2219421

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply elementary transformations to find the rank and inverse.	Apply	1	1, 2, 9, 10, 12
2	Solve the Ordinary differential equations.	Apply	2	1, 2, 9, 10, 12
3	Apply the differential equation in various problems.	Apply	2	1, 2, 9, 10, 12
4	Examine the consistency of the system of linear equations.	Analyze	1	1, 2, 9, 10, 12

TEXT BOOKS:

1. N. P. Bali, K. L. Sai Prasad, “A Textbook of Engineering Mathematics I, II, III”, 2nd Edition Universal Science Press, New Delhi, 2018.
2. B. S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, 2018.

REFERENCE BOOKS:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons, Inc., 2015
2. H. K. Dass and Er. RajanishVerma, “Higher Engineering Mathematics”, Third revised edition, S. Chand & Co., 2015.
3. B. V. Ramana, “Advanced Engineering Mathematics”, TMH Publishers, 2020.

22PY101 APPLIED PHYSICS

Hours Per Week :

L	T	P	C
2	-	2	**3**

PREREQUISITE KNOWLEDGE: Basics of atomic structure and electronic transitions, Bonding in solids, and concept of waves.

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of this course is to present the principles and concepts of Light and Sound waves. It enunciates the concurrent understanding of Lasers and Optical Fibers. It emphasizes on the principles and applications of Nano materials as relevant to an Engineer.

MODULE-1

UNIT-1 **8L+0T+8P =16 Hours**

PHYSICAL OPTICS:

Interference: Introduction-Superposition principle -Types of superposition of waves – Division of wave front, Division of amplitude, Newton rings- Experiment – Diameter of Newton rings (bright & dark), Determination of wavelength – Determination of Refractive Index.

Diffraction: Introduction- Interference versus Diffraction – Types of diffraction, Fraunhofer diffraction at single and double slit (Qualitative), Plane transmission diffraction grating (Qualitative) – Determination of wavelength.

Polarization: Polarized and unpolarized light, Production of polarized light, Nicol prism, Quarter and half wave plates, Optical activity - Laurent's half shade polarimeter.

UNIT-2 **8L+0T+8P=16 Hours**

LASERS AND FIBRE OPTICS:

Lasers: Characteristics of laser light – spontaneous and stimulated emission, Population Inversion – Pumping Processes –He-Ne laser, Semiconductor laser and applications of lasers, Holography – construction – reconstruction and applications.

Fiber Optics: Principle of optical fibre – acceptance angle, numerical aperture, Types of fibres– Step Index fiber – Gradded Index fiber - Fibre optic sensor-Biosensors

PRACTICES:

- **Newtons rings**: Determination of wavelength of a given light source.
- **Diffraction grating**: Determination of wavelength – Normal Indcidence method.
- **Polarimeter**: Determination of Optical rotation of an optically active solution.
- **Laser**: Determination of wavelength of a given LASER source using plane diffraction grating.

MODULE-2

UNIT-1 **8L+0T+8P =16 Hours**

CRYSTAL PHYSICS:

Crystal Physics:Crystal Physics: - Introduction-Fundamental terms of crystal physics, Lattice parameters and Crystal systems, packing factor for SC, BCC and FCC –Miller indices – Rules to find Miller Indices – Important features of Miller Indices – Distance of separation between successive (h k l) planes (Qualitative), XRD and Bragg's law.

SKILLS:

- ✓ *Apply the dynamics of Light to realize the various potential applications in Engineering.*
- ✓ *Evaluate the concepts of Lasers and Optical Fibers to realize versatile applications in Science, Engineering and Technology.*
- ✓ *Analyze the Crystal Structures and orientation of planes.*
- ✓ *Appraise the importance of Ultrasonics in medicine.*
- ✓ *Demonstrate the synthesis and characterization of Nano materials in view of their applications.*

UNIT-2 **8L+0T+8P=16 Hours**

ELEMENTS OF NANOMATERIALS:

Elements of Nano Materials: Introduction- Principles of Nano materials, Synthesis of Nanomaterials: top- down and bottom- up approaches – Ballmilling – Sol-gel, Applications of nanomaterials, Characterization of nanomaterials by electron microscopy (SEM-Construction – Working – Applications), TEM- (Construction – Working – Applications), AFM – Construction – Working – Applications.

PRACTICES:

- **Band gap:** Determination of Energy bandgap of a semiconductor.
- **Optical fibre:** Determination of a Numerical Aperture of an Optical Fibre
- **LED:** Study of V-I characteristics of LED
- **Ultrasonic interferometer:** Determination of Ultrasonic wave velocity in liquid medium.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of Physical Optics in the perspective of Engineering applications	Apply	1	1, 3, 5, 6, 7
2	Recognise the importance of Crystal Physics relevant to Bio-Physical systems	Apply	2	1, 2, 4, 5, 6, 7, 9
3	Analyse the wavelengths of Laser for applications in medicine and to foster the knowledge on Optical Fibers to realize Fiber Optic Sensors	Analyze	1	1, 3, 5, 6, 7
4	Connect the dimensions of Nano particles to consolidate the Physical and Chemical aspects of Nano materials	Analyze	2	1, 3, 5, 6, 9, 11, 12
5	Evaluate Ultrasonic waves to apply them in medical diagnostics	Evaluate	2	1, 2, 4, 5, 6, 7, 9

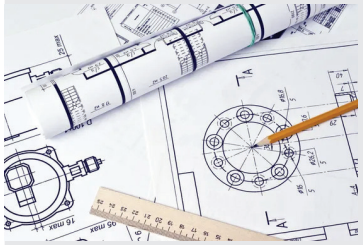
TEXT BOOKS:

1. S.O.Pillai, “Solid State Physics”, New age International publishers, 8th edition, 2018.
2. M.R. Srinivasan, “Engineering Physics”, New Age International Publishers, 1st edition 2008.

REFERENCE BOOKS:

1. M.N. Avadhanulu, P.G. Kshirsagar and T.V.S. Aruen Murthy, “A Text Book of Engineering Physics”, 11th edition, S. Chand & Company Ltd., 2019.
2. Shatendra Sharma and Jyotsna Sharma, “Engineering Physics”, Pearson India Education Services Pvt. Ltd., 2018.
3. D. Halliday, R. Resnick and J. Walker “Fundamentals of Physics”, 6th edition, John Wiley and Sons, 2020.
4. T. Pradeep, “A Text Book of Nanoscience and Nanotechnology”, Tata Mc-Graw Hill, 2018.

22ME101 ENGINEERING GRAPHICS



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Hours Per Week :

L	T	P	C
2	-	2	**2**

PREREQUISITE KNOWLEDGE: Basics of Geometry

COURSE DESCRIPTION AND OBJECTIVES:

Engineering graphics is the language of engineers and is the most effective way of communicating and sharing technical ideas in the form of pictures/drawings. The objective of this course is to familiarize the students with the conventional concepts of engineering drawing and computer aided drawing.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

ENGINEERING CURVES:

Types of lines; Lettering, Dimensioning, Geometric constructions - lines, polygons (Angle, ARC, General and Inscribe in circle method), Conical curves (General method), Ellipse by Oblong method.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC PROJECTIONS OF POINTS, LINES & PLANES:

Principles of projection; Projections of points; Projection of straight lines - Inclined to one plane, inclined to both planes; Projection of planes - Inclined to one plane.

PRACTICES:

- Construction of polygons using different methods (i.e. ARC, Angle, General).
- Inscribe a regular hexagon & pentagon in a circle of the given diameter.
- Tracing of conical curves (Ellipse, Parabola, Hyperbola) by using General Method.
- Draw the projections of the points situated in all the 4 quadrants.
- Draw the projections of a line when it is inclined to one plane (HP or VP).
- Draw the projections of a line when it is inclined to both the planes (HP &VP).
- Draw the projections of a plane when it is inclined to one plane (HP or VP).

MODULE-2

UNIT-1 **4L+0T+12P=16 Hours**

PROJECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES:

Projections of Solids: Projection of solids axis inclined to one reference plane - Prisms, pyramids, Cylinder and cone.

Development of Surfaces: Development of lateral surfaces of simple solids - Prisms, Pyramids, Cylinder and cone.

UNIT-2 **5L+0T+15P=20 Hours**

ORTHOGRAPHIC VIEWS AND DRAFTING USING COMPUTER PACKAGE:

Orthographic Views: Conversion of pictorial views into orthographic views.

Drafting Using Computer Package: Introduction to 2D modelling software - AutoCAD; Conversion of Isometric view into Orthographic views of simple castings; Conversion of Orthographic views into Isometric view of simple solids - Prisms, Pyramids, Cylinders and cones.

SKILLS:

- ✓ *Convert iso-metric views of objects into orthographic views and vice versa*
- ✓ *Visualize the shape of the 3D components*
- ✓ *Create pictorial views by using AutoCAD*
- ✓ *Understand projections by visualization.*

PRACTICES:

- Draw the projections of Prisms, when they are inclined to one reference plane (HP or VP)
- Draw the projections of Pyramids, when they are inclined to one reference plane (HP or VP)
- Draw the projections of cylinder & cone, when they are inclined to one reference plane (HP or VP)
- Draw the complete surface development of prisms & pyramids with the given dimensions
- Draw the complete surface development of cylinder & cone with the given dimensions
- Draw the orthographic view's (i. e. front view, top view, and side view) of the given pictorial view of the sketches by using AutoCAD
- Draw the Isometric view of simple solids (Prisms & Pyramids) by using AutoCAD
- Draw the Isometric view of simple solids (Cylinder & Cone) by using AutoCAD

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Communicate the technical ideas in the form of drawings	Apply	1	1,2,3,5
2	Apply the drawing skills in representing various geometrical features	Apply	1	1,2,3,5
3	Develop orthographic projections and isometric views of various objects	Apply	1	1,2,3,5
4	Estimate the lateral surface area of regular geomet-rical solids	Analyze	2	1,2,3,5
5	Sketch simple objects and their pictorial views using AutoCAD	Analyze	2	1,2,3,5

TEXT BOOKS:

1. J Hole, "Engineering Drawing", 2nd edition, Tata McGraw-Hill, 2019.
2. N D Bhatt, "Engineering Drawing", 53rd edition, Charotar Publication, 2014

REFERENCE BOOKS:

1. Basant Agrawal and C.M. Agrawal "Engineering Drawing", 2nd edition, Tata Mc Graw- Hill, 2018
2. K L Narayana, "Engineering drawing", 3rd edition, SciTech Publications, 2011
3. Colin H. Simmons, Dennis E. Maguire, Manual of Engineering Drawing, 2nd edition,2003

22TP104 BASIC CODING COMPETENCY

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

Hours Per Week :

L	T	P	C
-	1	3	2

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on advanced concepts of C programming language and problem solving. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE-1

UNIT-1 **0L+4T+12P=16 Hours**

NUMBER CRUNCHING:

PRACTICES:

Problems On Number Crunching

- Write a program to check if a given number is perfect or not.
- Write a program to check if a given number is deficient or not.
- Write a program to check if 2 given numbers are amicable or not.
- Write a program to check if 2 given numbers are betrothed or not.
- Write a program to check whether a given number is an Armstrong number or not.
- Write a program to print the series of prime numbers in the given range.
- Write a program to print all the perfect numbers in a given range.
- Write a program to generate all deficient numbers in a given range.
- Write a program to generate all the amicable numbers in a given range.
- Write a program to generate all the betrothed numbers in a given range.
- Write a program to find the largest prime factor of a given number.
- Write a program to check whether the given number is a palindrome or not.
- Write a program to calculate sum of the individual digits for the given number.
- Write a program to find the first number that has more than ‘n’ factors, excluding 1 and that number.
- Write a program to accept a number as input and print its factorial.
- Write a program to accept a number n, print first N Fibonacci numbers.
- Write a program to check if an input number is Armstrong number or not.
- Write a program that takes input a,b. Print a power b.
- Write a program that takes input a number n, check if it a perfect square or not.
- Print array in spiral format.
- Print sum of each row in a matrix.
- Print sum of each column in matrix.
- Print left->right and right->left diagonals in a matrix.
- Initially you are at (0,0) find the shortest path count to reach the (n, n) block in matrix.
- Remove all the elements present in row and column of unsafe elements. An element is called unsafe if it is equal to smallest or largest value. Count number of remaining elements.
- Write a program to check if the string contains all the letters of alphabet.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- Check if a string is matching password requirements.
- Check if String A contains String B (String searching).
- Check if a number is harshad number or not.
- Write a program to get 3 numbers as input. The first is the number num1 and second is the digit that needs to be replaced. The third is the digit that is to replace the 2nd digit. Print the number after performing this operation.
- Write a program to accept a number and swap its alternate digits. Print the number generated.
- Write a program to accept a number and choice as input. If the choice is 0 rearrange the number such that the odd digits are ordered first followed by the even digits. If the choice is 1 rearrange the number such that the even digits are ordered first followed by the odd digits. Print the rearranged number. The order of occurrence of the digits is to be preserved.
- Write a program to determine that whether the given quadrilateral is cyclic or not. You are given the sizes of angles of a simple quadrilateral (in degrees) A, B, C and D, in some order along its perimeter.

  Note: A quadrilateral is cyclic if and only if the sum of opposite angles is 180^0.
- Chef is a very lazy person. Whatever work is supposed to be finished in x units of time, he finishes it in m*x units of time. But there is always a limit to laziness, so he delays the work by at max d units of time. Given x,m,d, find the maximum time taken by Chef to complete the work.
- Suppose Chef is stuck on an island and currently he has x units of food supply and y units of water supply in total that he could collect from the island. He needs xr units of food supply and yr units of water supply per day at the minimal to have sufficient energy to build a boat from the woods and also to live for another day. Assuming it takes exactly D days to build the boat and reach the shore, tell whether Chef has the sufficient amount of supplies to be able to reach the shore by building the boat? Read five integers x,y,xr,yr,D from the user and display “YES” if Chef can reach the shore by building the boat and “NO” if not (without quotes).
- There are 3 problems in a contest namely A,B,C respectively. Alice bets Bob that problem C is the hardest while Bob says that problem B will be the hardest.

  You are given three integers SA,SB,SC which denotes the number of successful submissions of the problems A,B,C respectively. It is guaranteed that each problem has a different number of submissions. Determine who wins the bet.

  1) If Alice wins the bet (i.e. problem C is the hardest), then output Alice.

  2) If Bob wins the bet (i.e. problem B is the hardest), then output Bob.

  3) If no one wins the bet (i.e. problem A is the hardest), then output Draw.

  Note: The hardest problem is the problem with the least number of successful submissions.

  Input Format

  - The first line of input contains a single integer T denoting the number of test cases. The description of T test cases follows.
  - The first and only line of each test case contains three space-separated integers SA,SB,SC, denoting the number of successful submissions of problems A,B,C respectively.

  Output Format

  For each test case, output the winner of the bet or print Draw in case no one wins the bet.

  Sample Input 1

  3

  1 4 2

  16 8 10

  14 15 9

  Sample Output 1

  Draw

  Bob

  Alice

- In a season, each player has three statistics: runs, wickets, and catches. Given the season stats of two players A and B, denoted by R, W, and C respectively, the person who is better than the other in the most statistics is regarded as the better overall player. Tell who is better amongst A and B. It is known that in each statistic, the players have different values.

  Input

  The first line contains an integer T, the number of test cases. Then the test cases follow.

  Each test case contains two lines of input.

  The first line contains three integers R1, W1, C1, the stats for player A.

  The second line contains three integers R2, W2, C2, the stats for player B.

  Output

  For each test case, output in a single line "A" (without quotes) if player A is better than player B and "B" (without quotes) otherwise.

- Write a program to find the direction.

  Chef is currently facing the north direction. Each second he rotates exactly 90 degrees in clockwise direction. Find the direction in which Chef is facing after exactly X seconds.

  Note: There are only 4 directions: North, East, South, West (in clockwise order). Initially chef is at 0th second i.e., facing North direction.

  Input Format

  - First line will contain T, number of testcases. Then the testcases follow.
  - Each testcase contains of a single integer X.

  Output Format

  For each testcase, output the direction in which Chef is facing after exactly X seconds.

  Sample Input 1

  3

  1

  3

  6

  Sample Output 1

  East

  West

  South

- Chef is playing in a T20 cricket match. In a match, Team A plays for 20 overs. In a single over, the team gets to play 6 times, and in each of these 6 tries, they can score a maximum of 6 runs. After Team A's 20 overs are finished, Team B similarly plays for 20 overs and tries to get a higher total score than the first team. The team with the higher total score at the end wins the match.

  Chef is in Team B. Team A has already played their 20 overs, and have gotten a score of R. Chef's Team B has started playing, and have already scored C runs in the first O overs. In the remaining 20−O overs, find whether it is possible for Chef's Team B to get a score high enough to win the game. That is, can their final score be strictly larger than R?

  Input: There is a single line of input, with three integers, R, O, C.

  Output: Output in a single line, the answer, which should be "YES" if it's possible for Chef's Team B to win the match and "NO" if not.

- Make Array Zeros using pointers

  You are given an array A of length N (size should be created using Dynamic memory allocation) and can perform the following operation on the array:

  Select a subarray from array A having the same value of elements and decrease the value of all the elements in that subarray by any positive integer x.

  Find the least possible number of operations required to make all the elements of array A equal to zero.

The first line contains an integer N denoting the number of elements in the array.

The next line contains space-separated integers denoting the elements of array A.

Print the least possible number of operations required to make all the elements of array A equal to zero.

Sample Test case

Input:

5

2 2 1 3 1

Output:

4

UNIT-2 **0L+4T+12P=16 Hours**

PATTERNS

PRACTICES:

Problems on Number Patterns

- Write a program to generate Floyd triangle. Sample input N= 4.
  1
  2 3
  4 5 6
  7 8 9 10
- Write a program to generate the following pattern. Sample input N=5.
  13579
  3579
  579
  79
  9
- Write a program to generate the following pattern. Sample input N=4.
  1111111
  222222
  33333
  4444
  333
  22
  1
- Write a program to generate the following pattern. Sample input N=5.
  5432*
  543*1
  54*21
  5*321
  *4321
- Write a program to generate the following pattern. Sample input N=5.
  12 21
  123 321
  1234 4321
  123454321

- Write a program to generate the following pattern. Sample input N=5.

```
1
2*2
3*3*3
4*4*4*4
4*4*4*4
3*3*3
2*2
1
```

- Write a program to generate the following pattern. Sample input N=4.

```
1
212
32123
4321234
```

- Write a program to generate the following pattern. Sample input N=5.

```
*
* *
* * * *
* *
*
```

- Write a program to print Pascal triangle for the given number of rows. Sample input N=5.

```
                1
            1       1
        1       2       1
    1       3       3       1
1       4       6       4       1
```

- Write a program to generate the following pattern. Sample input N=4.

```
1234
2341
3421
4321
```

- Print Hollow Diamond pattern.
- Print pascals triangle.
- Print Floyds triangle.
- Print Butterfly Pattern.
- Print palindromic pattern.
- Print full inverted number triangle.
- Check if a number is prime or not (Efficient Approach).
- Find sum of all the digits of the number.
- Print transpose of given matrix.
- Rotate a two dimensional matrix by 90, 180, 270 degrees.

MODULE-2

UNIT-1 **0L+4T+12P=16 Hours**

ARRAYS:

PRACTICES:

Problems On Arrays

- Given an unsorted array of size N, and the array elements are in the range of 1 to N. There are no duplicates, and the array is not sorted. One of the integers is missing. Write a program to find the missing number.
- Given an array consisting of only 0s and 1s in random order rearrange the array such that all the 0s are to the left of the array and 1s to the right.
- Give an array consisting of odd and even numbers in random order, rearrange the array such that all the odd numbers are to the left of the array and even numbers are to the right of the array.
- Write a program to find all the unique elements in an array.
- Write a program to merge two arrays of the same size sorted in descending order.
- Write a program to count the frequency of each element in an array of integers.
- Write a program to find the second largest element in an array.
- Write a program to find the second smallest element in an array.
- Write a program to find that one element in array that occurs odd number of times, where every other element appears even number of times.
- Create a jagged array (adjacency list representation of a graph) with no of rows and no of columns in each row as specified by the user.
  Hint: Use Dynamic memory allocation (malloc() or calloc())

  Input:

  Enter no of rows: 3

  Enter no of columns Row in 1: 3

  Enter no of columns Row in 2: 5

  Enter no of columns Row in 3: 2

  Enter the elements row wise:

  8 6 5

  8 4 6 9 7

  9 2

  Output:

  8 6 5

  8 4 6 9 7

  9 2
- Write a program to find second largest number in the array.
- Write a program to find first repeating element in the array.
- Write a program to left rotate the array.
- Write a program to right rotate the array.
- Write a program to find the largest continuous sum.
- Write a program to print the sum of 2nd largest and 2nd smallest elements.
- Write a program to find the maximum product of two numbers multiplies in array (same index should not be used twice).
- Rearrange an array consisting of 1s and 0s such that they are alternatively arranged. Print minimum number of moves required.
- In a given array, find two numbers whose sum equal k.
- Find the difference between positive and negative elements in the array.
- Implement sorting algorithms (Insertion, selection, bubble).

UNIT-2 **0L+4T+12P=16 Hours**

STRINGS:

PRACTICES:

Problems on Strings:

- Write a program to reverse a given string word by word.
- Write a program to find the first occurrence of non-repeating character in the given string.
- Write a program to compress the string as provided in the example.
- Write a program to expand a string as provided in the example.
- Write a program to reverse those words of a string whose length is odd.
- Write a program to check if a given matrix is symmetric or not.
- Write a program to convert all the cases of letter (Lower case -> Upper Case, Upper Case-> Lower Case).
- Write a program to reverse all the words (Not the entire sentence but individual words).
- Find the longest palindrome in a given string.
- Check if two strings are anagrams or not.
- Find minimum number of changes to be done to make a string palindrome.
- Convert Excel sheet name to number (A-1, B-2, Z-26, AA-27).
- Find number of possible palindromes present in a string.
- Write a C program to read a string s, and determine the number of words in s.
  Example : s=oneTwoThree
  There are 3 words in the string: ‘one’, ‘Two’, ‘Three’.
- Write a C program that reads a string S and remove all duplicates characters from the given string S.
  NOTE: 1) Order of characters in output string should be same as given in input string.
  2) String S contains only lowercase characters [‘a’-’z’].
  Example: S = Vignanuniversity
  The program should generate the output as: Vignauersty
- Today Ron is reading the book. Due to some reason, he started hating the word ‘are’ (without quotes). So he decided to replace the substring ‘are’ with ‘R’. Write a C program that reads a line of message ‘s’ and replace the substring ‘are’ with ‘R’. Example: s= Howareyou.
  The program should generate the output as: HowRyou
- Write a program to concatenate the characters of the two given strings alternatively.
- Given a string S consisting of uppercase and lowercase letters, change the case of each alphabet in this string. That is, all the uppercase letters should be converted to lowercase and all the lowercase letters should be converted to uppercase.
  Input: Vignan University
  Output: vIGNAN uNIVERSITY
- Write a program to insert a given character at the beginning and end of the given string.
- Given two Strings A and B. They are said to be friends if ASCII sum of the each individual string is divisible by 4 else they are not friends. You need to find whether given two strings are friends or not.
  Sample Test case:
  Input:
  man nam
  vignan university
  Output:
  YES
  NO

- Write a program to find the frequency of each digit in the given string.

  Input Format

  The first line contains a string, which is the given number.

  Output Format

  Print ten space-separated integers in a single line denoting the frequency of each digit, indicate that the integers are from 0 to 9.

  Sample Input 0

  a11472o5t6

  Sample Output 0

  0 2 1 0 1 1 1 1 0 0

  Explanation 0

  In the given string:

  · 1 occurs two times.
  · 2,4,5,6 and 7 occur one time each.
  · The remaining digits and don't occur at all.

- Sherlock considers a string to be valid if all characters in the given string appear the same number of times. It is also valid if he can remove just 1 character at 1 index in the string, and the remaining characters will occur the same number of times.

  Write a C program that reads a string s and determine whether it is valid or not. If valid, return YES, otherwise return NO.

  Example: S=abc
  This is a valid string because frequencies are {a:1,b:1,c:1}
  S=abcc
  This is a valid string because we can remove one c and have 1 of each character in the remaining string.
  S=abccc
  This string is not valid as we can only remove 1 occurrence of c. That leaves character frequencies of {a:1,b:1,c:2}

- Read a string containing characters A and B only. Your task is to change it into a string such that there are no matching adjacent characters. To do this, you are allowed to delete zero or more characters in the string.

  Write a C program that finds the minimum number of deletions required.

  Example: S=AABAAB

  Remove A at positions 0 and 3 to make S=ABABA in 2 deletions.

  Input Format

  The first line contains an integer (the number of queries).

  The next q lines each contain a string s to analyze.

  Sample Input:

  5

  AAAA

  BBBBB

  ABABABAB

  BABABA

  AAABBB

  Sample Output:

  3
  4
  0
  0
  4

- Write a C program that reads a string 's' and it is said to be complete if it contains all the characters from a to z.
  Input Format
  First line of the input contains the number of strings N. It is followed by N lines each contains a single string.
  Output Format
  For each test case print "YES" if the string is complete, else print "NO"
  Constraints 1 <= N <= 10
  The length of the string is at max 100 & the string contains only the characters a to z.
- Write a C program that reads two strings and determine whether they share a common substring or not. A substring may be as small as one character.
  Example;
  S1=and
  S2=art
  The common substring in these two strings: a.
  Sample Input
  2
  hello
  world
  hi
  world
  Sample Output
  YES
  NO

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Write simple, but complete, C programs.	Apply	1,2	1
2	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
3	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
4	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
5	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3
6	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Create	1,2	3,4

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, "Programming for Problem Solving", 1st edition, Cengage publications, 2019.
2. Ajay Mittal, "Programming in C - A Practical Approach", 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, "Computer Fundamentals and Programming in C", 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, "C: The Complete Reference", 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, "Programming with C", 4th edition, Tata McGraw-Hill, 2018.

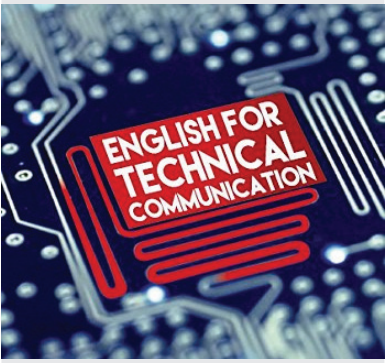


Image source: https://www.abebooks.com/9781316640081/English-Technical-Communication-Students-Book-1316640086/plp

22EN104 TECHNICAL ENGLISH COMMUNICATION

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basic sentence formation, Understanding contextual meanings, Basic writing skills and Moderate fluency in English.

COURSE DESCRIPTION AND OBJECTIVES:

In this course students will read, analyze, and interpret material from technical and general fields, and practice reading, writing, listening and speaking skills to gain exposure and functional English on a variety of contemporary topics. The overall course objective is to provide English for Specific Purposes(ESP) instruction to enhance students' reading, writing, listening and speaking skills through a practice in the language. It will aim to build students' confidence and motivation through exposure to academic skills like Note making/taking, Paraphrasing, Summarizing, Report Writing, Making Presentations etc., so as to generate interest in the language from an ESP perspective. Finally, students are expected through the course to gain key strategies and expression for communicating with professionals and non-specialists.

MODULE-1

UNIT-1 **8L+0T+8P=16 Hours**

GENETICS:

Reading: Reading for Note Making Sub skills: Reading for global understanding (skimming), specific information (scanning), understanding main ideas and supporting ideas, guessing contextual meanings from the text. -**Vocabulary building**: commonly used roots, prefixes, and suffixes.

Writing: Note making, organising main points and sub points, numbering and sequencing, suggesting titles, paraphrasing and summarising.

Functional grammar: Common Errors in Articles and Prepositions (Handout).

Listening: Listening for Note Taking: top down and bottom up approach, listening for main ideas and supporting points.

Speaking: Presentation in teams - ideas on the topic summarised, making a PPT, effective introductions and conclusions, logical organisation of content, using appropriate structure and cohesive devices.

UNIT-2 **8L+0T+8P=16 Hours**

ALIENS:

Reading : Predicting, skimming, scanning, reading for inference, extrapolative reading

Vocabulary building: Academic vocabulary from the text: synonyms, antonyms, Words often confused.

Writing : Paragraph writing; writing a topic sentence, supporting sentences, effective introductions and conclusions, use of cohesive devices. Types of Paragraphs: Descriptive, narrative, argumentative and expository.

Functional grammar: Common Errors in Verb forms and Conditional sentences (Handout).

Listening : Listening for identifying parts from a description, listening to and sorting information, listening for specific information.

Speaking : Narrating/Retelling an incident, using suitable cohesive devices/discourse markers Speaking of past and present habits/ activities/events - Speaking of future plans.

PRACTICES:

- Note making.
- Summarizing.
- Paragraph Writing.
- Error correction and Restructuring.
- Vocabulary building.
- Listening comprehension.
- Note taking.

SKILLS:

- ✓ *Apply different sub skills like skimming, scanning, reading for information, reading for inference etc. to understand different kinds of text.*
- ✓ *Apply different sub skills like top down, bottom up approaches to listening.*
- ✓ *Use functional vocabulary relevant to engineering and technology to express ideas lucidly.*
- ✓ *Use appropriate sentence structure, cohesive devices to construct simple text in regular correspondence like e-mails and letters.*

MODULE-2

UNIT - 1 **8L+0T+8P=16 Hours**

SOCIAL MEDIA – HEALTH AND NUTRITION:

Reading : Reading for factual information researching for supporting evidence - skimming, scanning, **Vocabulary building**: One-word substitutes.

Writing : Letter Writing- E-mail writing – New age communication – Format, protocol, and style- WhatsApp, Facebook and Twitter Functional grammar: Common Errors in Sub-Verb Agreement and Modals.

Listening : Listening to a Business Presentation: Listening for deducing information, for abstract details and specific details, listening for taking a message.

Speaking : Making a presentation with a PPT on a topic assigned- organising the presentation using appropriate discourse markers - presenting a point of view - Extempore.

UNIT-2 **8L+0T+8P=16 Hours**

FASHION:

Reading : Reading for data interpretation and information transfer from graphical aids to text reports (pictograms. tables, graphs, pie charts, flow charts), deducing specific information and general information

Vocabulary building: Business vocabulary, collocations, idioms and phrasal verbs.

Writing: Writing a Report: Drafting general and factual reports - writing an overview - an effective introduction - organising information into paragraphs (Stages of writing: planning /organising /writing / editing /rewriting)

Functional grammar: Transformations and miscellaneous common errors.

Listening : Listening to a Ted talk and sorting information – taking notes from a discussion.

Speaking : Group Discussion – prerequisites -generating content - initiating a discussion - expressing one's opinion ~ leading a discussion - agreeing/ disagreeing to someone's view - cutting into a speech - body language and voice modulation.

PRACTICES:

- E-mail writing.
- Letter writing.
- Report writing.
- Messaging in Social media.
- Extempore.
- Making PPTs.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.	Apply	1	6, 7, 8, 9, 10, 12
2	Apply appropriatereading strategies to interpret content / material related to engineering and technology domain.	Apply	1	6, 7, 8, 9, 10, 12
3	Choose functional language, grammar structures, cohesive devices and skills of organisation to express clearly in speaking.	Evaluate	2	6, 7, 8, 9, 10, 12
4	Participate in discussions and make short presentations on general and technical topics.	Create	2	6, 7, 8, 9, 10, 12
5	Possess an ability to write clearly on topics related to technology and workplace communication.	Create	2	6, 7, 8, 9, 10, 12

LANGUAGE LAB ACTIVITIES:

Session - 1: Dictionary Skills

Session - 2: Introduction to Phonetics and Identifying Phonemes

Session - 3: Pronunciation Practice (Commonly mispronounced words)

Session - 4: Rosetta Stone (Exercises on LSRW)

Session - 5: Listening Comprehension (Summarising exercise on a Ted Talk)

Session - 6: Technical Presentations (Individual)

Session - 7: Technical Presentations (Team)

Session - 8: TOEFL Mastery

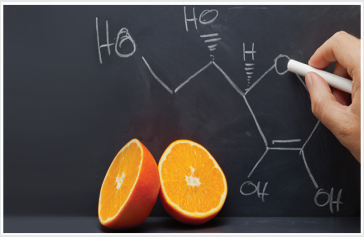
TEXT BOOK:

1. N P Sudharshana & C Savitha, “English For Technical Communication”, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Balasubramanian T,“A Text book of Phonetics for Indian Students”, Orient Longman, New Delhi, 1989.
2. Krishnaswamy, N and Sriraman, T, “Current English for Colleges”, Trinity publications, 2016.
3. Mohan Krishna and Meera Banerjee, “Developing Communication Skills”, Macmillan India Ltd. New Delhi, 1990.
4. Ashraf Rizvi M, “Effective Technical Communication”, 2nd Edition, McGraw Hill Education, 2017.
5. Narayana Swamy V R, “Strengthen your Writing”, Third Edition Orient Black Swan, New Delhi, 2005.

22FT102 FOOD CHEMISTRY



https://byjus.com/chemistry/food-chemistry-impact-factor/

Hours Per Week :

L	T	P	C
3	-	2	4

PREREQUISITE KNOWLEDGE: Basics of Food Chemistry, its importance in product development.

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to understand the various aspects of components present in food like moisture, the role of enzymes, and pigments in food processing followed by the importance of nutraceuticals, various toxins present in foods, elimination, and biotransformation reaction, to know about the food safety standards in product development.

MODULE–1

UNIT-1 **20L+0T+0P=20 Hours**

BASIC CONCEPTS OF FOOD CHEMISTRY:

Introduction: Role and importance of water, types of water, water activity, sorption isotherm; Definition, function, classification and nomenclature of enzymes, coenzymes, mechanism of enzyme action. Enzyme kinetics, enzyme inhibition.

Chemistry of food colour and flavor: Natural pigments- Heme pigment, Chlorophyll, Carotenoids, phenolics and flavonoids; Flavour- philosophy and definition of flavor, flavouring compounds, sensory assessment of flavour, the effect of processing on flavour and colour, technologies for colour and flavour retention.

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UNIT-2 **4L+0T +16P=20 Hours**

APPLICATION OF FOOD CHEMISTRY:

Open circuit (impedance), Short circuit (admittance), Transmission (ABCD) and Inverse Transmission, Hybrid and Inverse hybrid parameters, Inter relation between them, Inter connection of 2-port networks.

PRACTICES:

- Determination of moisture content
- Proximate analysis of food samples
- Assay of amylases, and lipases.
- Determination of chlorophyll.
- Determination of carotenoids.
- Determination of lycopene.

MODULE–2

UNIT-1 **20L+0T +0P=20 Hours**

NUTRACEUTICALS AND FOOD TOXICOLOGY:

Introduction: Nutraceuticals and functional foods: Definition & classification, functional food components and their role in specific diseases- cancer, heart, stress; Hypertension as a nutraceutical and functional food; Food application and health benefits; Regulatory guidelines on nutraceutical and functional food, prebiotics & probiotics.

Food Toxicology: Classification of food toxicants, exposure; Dose-response curve, terms in toxicology, adsorption, distribution, and elimination of toxicant; Natural toxins in food- plant origin, marine, microbial, during processing; Pesticide residue.

SKILLS:

- ✓ *Perform analytical techniques associated with food using basic analytical instrumentation.*
- ✓ *Critically analyze the chemical information, synthesize the information and validate it.*
- ✓ *Select appropriate analytical technique when presented with a practical problem.*

UNIT-2 **4L+0T +16P=20 Hours**

PRACTICAL APPLICATION OF NUTRACEUTICALS, FUNCTIONAL FOODS AND FOOD TOXICOLOGY:

PRACTICES:

- Identification and quantification of bioactive compounds.
- Development and formulation of functional food products.
- Identification of common adulterants in a food sample.
- Identification of common dyes in a food sample.
- Determination of anti-nutritional factors- Tannins, Phytic acid, Saponin etc.
- Case studies and surveys on different toxicants present in plant and animal sources.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the relationship between the chemical composi-tion of food and food quality.	Apply	1	1,2
2	Elucidate why certain ingredients are used in food and major chemical reactions that limit the shelf-life of foods.	Apply	1, 2	1,2,4
3	Explicate the rationale for certain food processes	Analyze	1, 2	1,2,4,12
4	Identification and elimination of toxins generated through various food processing aspects	Analyze	1, 2	2,3,4
5	Synthesize two port networks.	Create	1	1,2,9,12

TEXT BOOKS:

1. DeMan, J. M., Finley, J. W., Hurst, W. J., & Lee, C. Y. Principles of food chemistry, 4th Edition. Springer. 2018.
2. Owen R, Fennema. 2017. Food Chemistry, 5th Edition. Marcel Dekker, Inc., New York, USA

REFERENCE BOOKS:

1. Belitz, Grosch, Schieberle. “Food Chemistry”, 2nd Edition. Springer-Verlag Berlin Heidelberg 2013
2. Roshan Chaudhary, “Basics of Food Chemistry”, 2nd edition. Anmol publications, 2008.
3. Alex V Ramani, “Food Chemistry. www.mjppublishers.com. 2014.

II

YEAR

B.Tech.

FOOD TECHNOLOGY

I SEMESTER

- Environmental Studies
- Data Structures
- Fundamentals of Fluid Mechanics
- Food Microbiology
- Principles of Food Preservation and
- Engineering Thermodynamics
- Department Elective – 1

II SEMESTER

- Advanced Coding Competency
- Professional Communication
- Fruits and Vegetables Processing
- Heat and Mass Transfer
- Management Science
- Life Skills
- Probability and Statistics
- Open Elective – 1

COURSE CONTENTS

I SEM & II SEM

22CT201 ENVIRONMENTAL STUDIES

Image source: Biogas plant at VFSTR

Hours Per Week :

L	T	P	C
1	1	0	1

PREREQUISITE KNOWLEDGE: General awareness regarding environmental problems and importance of environmental protection..

COURSE DESCRIPTION AND OBJECTIVES:

It is a multidisciplinary subject where we deal with different aspects using a holistic approach. It is evolving to be the education for sustainable and ethical development both at a local and global level. It helps to prepare the next generation and to plan appropriate strategies for addressing environmental issues. It identifies and create solutions that conserve to manage ecosystem and biodiversity and also helps to eliminate pollutants, toxicants to preserve air, water and soil quality. Environmental education recognize impacts of global issues, enhances the public awareness and helps to take decisions towards environmentally responsible actions.

MODULE-1

UNIT-1 **4L+4T+0P=8 Hours**

INTRODUCTION TO ENVIRONMENT: NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY:

Environment and sustainable development; Natural resources- forest, water, energy and land resources; Ecosystem – basic structural components, function and interactions in ecosystem, ecological succession.

UNIT-2 **4L+4T+0P=8 Hours**

BIODIVERSITY AND CONSERVATION:

Introduction to biodiversity, types of biodiversity- species, genetic and ecosystem diversity; Threats to biodiversity - natural and anthropogenic, species extinctions, man wildlife conflicts; Biodiversity conservation - principles and strategies; in-situ and ex-situ conservation.

PRACTICES:

- Visit to a Biogas plant, Solar Power plant.
- Visit to a local area: river / pond / lake / forest / grassland / hill / mountain and study of different types of ecosystems, biodiversity study and documentation (herbarium sheet preparation).
- Set up an aquarium.
- Case study: Renewable energy use.

MODULE-2

UNIT-1 **4L+4T+0P=8 Hours**

ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE:

Air, water, soil, radioactive and noise pollution; Study of different pollutants (SOx, NOx, PAN, PAH etc.); Toxicity study; Climate change - greenhouse effect, acid rain, ozone layer depletion.

UNIT-2 **4L+4T+0P=8 Hours**

POLLUTION CONTROL DEVICES AND WASTEWATER TREATMENT TECHNOLOGIES:

Air pollution control devices - Gravitational settling chambers, cyclonic separators, electrostatic precipitators, fabric filters and bio filters, Wastewater management.

SKILLS:

- ✓ *Create a bio-diversity map of any habitat/ ecosystem.*
- ✓ *Strategize different ways of using renewable energy resources.*
- ✓ *Design novel strategies and approaches for pollution control and waste management.*

PRACTICES:

- Visit to a sewage treatment plant and wastewater analysis.
- Case study: Recycling Technologies.
- Case study: Effects of contaminants on microorganisms.
- Report writing: 12 principles of green chemistry for environmental sustainability.
- Report writing: Environmental Impact Analysis, Local Disaster Management Plan.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic concepts of sustainable development, natural resource utilization and ecology for the purpose of environmental protection	Apply	1	1,6,7, 9, 10, 11, 12
2	Design remediation technologies for their abatement	Apply	2	1, 3,6,7, 9, 10, 11, 12
3	Analyze the biodiversity of different ecosystems and formulate various conservation approaches	Analyze	1	1, 7, 8, 9, 10, 11, 12
4	Analyze the presence of various environmental pollutants	Analyze	2	1, 6,7,9, 10, 11, 12
5	Recommend various waste management approaches and their implementation strategies	Evaluate	2	1,2, 7,8,9,10,11, 12

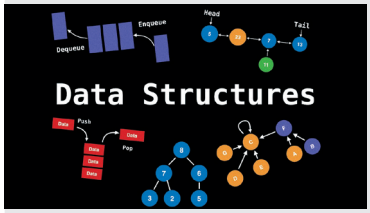
TEXT BOOKS:

1. A. Kaushik and C. P. Kaushik, “Perspectives in Environmental Studies”, New Age International Publishers, 5th Edition, 2016.
2. Y. Anjaneyulu, “Introduction to Environmental Science”, B. S. Publications, 2015.

REFERENCE BOOKS:

1. B. Joseph, “Environmental Studies”, Mc Graw Hill Education, 2nd Edition, 2015.
2. S. Subash Chandra, “Environmental Science”, New Central Book Agency, 2011.
3. M. Basu and S. Xavier, “Fundamentals of Environmental Studies”, Cambridge University Press, 2016.
4. K. Mukkanti, “A Textbook of Environmental Studies”, S. Chand Company Ltd., 2009.
5. M. Anji Reddy, “A Textbook of Environmental Science and Technology”, B. S. Publications, 2008.

22TP201 DATA STRUCTURES



Source: https://www.youtube.com/watch?v=Qmt0QwzEmh0

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION & OBJECTIVES:

This course is aimed at offering fundamentals concepts of data structures and explains how to implement them. It begins with the basic concepts of data, data structures and then introduces the primitive and non-primitive data structures in detail. It forms the basis for understanding various ways of representing data and its usage in different computing applications.

MODULE-1

UNIT-1 **5L+6T+6P = 17 Hours**

DATA STRUCTURES BASICS:

Basic Terminology – data, information, datatype; Data Structures – Introduction, storage structures-sequential and linked storage representations; classification of data structures; Applications of data structures.

Sorting: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort and Merge Sort.

Searching: Linear Search and Binary Search.

UNIT-2 **11L+10T+10P = 31 Hours**

LINKED LISTS AND STACKS, QUEUES:

Linked List: Introduction, Types of linked list – Singly linked list, doubly linked list and circular linked list, representation of linked list, Operations of linked list: Traverse forward/ reverse order, searching, insertion and deletion; Applications of linked lists.

Stack – Introduction, array and linked representations, implementation and their applications; Queue – Introduction, array and linked representations, implementation; Types – Linear, circular and doubly ended queues – operations; Applications of Queues.

PRACTICES:

Problems on Recursion – Level 1

- Find the product of 2 numbers using recursion.
- Find the sum of natural numbers using recursion.
- Find the factorial of a number using recursion.
- Find the Nth term of Fibonacci series using recursion.
- Calculate the power using recursion.
- Write a recursive program for checking if a given number is a prime number.
- Given two integers write a function to sum the numbers without using any arithmetic operators.
- Convert a decimal to binary using recursion.
- Print all factors using recursion.
- Find the maximum product of digits among numbers less than or equal to N.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

Problems Recursion – Level 2

- Implement insertion sort recursively.
- Write a program to find the numbers less than N that are product of exactly 2 distinct prime numbers - using recursion.
- Implement selection sort recursively.
- Find the middle of a singly linked list using recursion.
- Find the sum of even numbers of an array using recursion.
- Check if a given array is in sorted order using recursion.
- Print alternate nodes of a linked list using recursion.
- Reverse a doubly linked list using recursion.
- Write a recursive function that returns all permutations of a given list.
- Implement bubble sort recursively.

Problems on Sorting and Searching – Level 1

- Implement the insertion sort function.
- Implement the bubble sort function.
- Implement the quick sort function.
- Implement the merge sort function.
- Implement the selection sort function.
- Implement linear search function.
- Implement binary search function.

Problems on SLL – Level 1

- Implement the insert function to insert nodes into a singly linked list (ascending order).
- Implement the insert function to insert nodes into a singly linked list (descending order).
- Implement the search node function.
- Implement the delete node function.
- Display forwards function.
- Display backwards function.
- Count the number of nodes in a singly linked list.
- Swap alternate nodes of a singly linked list.
- Move last node to the front of the linked list.
- Move first node to the last of the linked list.

Problems on Stacks – Level 1

- Implement two stacks using a single array.
- Given an array replace every element with nearest greater element on the right.
- Given a stack reverse the elements using only push and pop functions.
- Postfix evaluation using stack.
- Balance symbols.
- Find middle element in a stack.
- Remove middle element from a stack.
- Implement push and pop using linked list.
- Given an array of characters with the middle marked by X, check if the string is a palindrome.
- Maximum sum in sliding window.

Problems on Queues – Level 1

- Write a program to accept two numbers as input check if they are equal.
- Write a program to accept two characters as input and check if they are equal.
- Write a program to accept two numbers as input and print the greater of the 2 numbers.
- Write a program to accept two numbers as input and print the lesser of the 2 numbers.
- Write a program to accept 3 numbers as input and print the maximum of the 3.
- Write a program to accept 3 numbers as input and print the minimum of the 3.
- Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
- Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
- Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
- Write a program to accept a number as input and check if it is positive, negative or zero.

Problems on DLL – Level 1

- Implement insert function.
- Implement display forward function.
- Implement display backward function.
- Implement search function.
- Implement delete function.
- Reverse a doubly linked list from M to N.
- Find the sum of the odd and even nodes.
- Count odd keys of the linked list.
- Merge two sorted lists.
- Delete adjacent duplicate nodes.

Problems on CLL – Level 1

- Insert function (circular doubly linked list).
- Search function.
- Display forward.
- Display backward.
- Delete node (circular doubly linked list).
- Print the middle N nodes of a circular singly linked list.
- Move the last node of a circular singly linked list to the beginning.
- Delete adjacent duplicate nodes of a circular singly linked list.
- Delete nodes greater than a value from a circular doubly linked list.
- Find the sum of the nodes of a circular linked list.

Problems on Linked List – Level 2

- Given 2 sorted linked lists, print the common elements.
- Reverse a list (using Stack).
- Given a pointer to a node (not the last node), delete the node.
- Reverse a list (Recursive).
- Reverse a list (Iterative).
- Reverse a singly linked list in pairs (recursive).
- Reverse a singly linked list in pairs (iterative).
- Check if a singly linked list is a palindrome or not.
- Remove the loop if exists.
- Given 2 linked lists with data in the ascending order, merge them into a single list.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

TREES:

Trees: Basic Terminology, Types of Trees, Binary Tree – Introduction, properties, array and linked representations; Tree traversals and their implementation; Expression trees; BST – definition and operations, AVL trees – definition and construction; Applications of binary trees.

UNIT-2 **8L+8T+8P=24 Hours**

GRAPHS & HASHING:

Graphs: Basic Terminology, Types of Graphs, Graphs representations – adjacency matric, adjacency list; Traversals - breath first search and depth first search; Applications of graphs.

Hashing: Introduction, Different hash functions, collision: avoidance and handling methods.

PRACTICES:

Problems on BST – Level 1

- Insert function.
- Insert function (recursive).
- Search function.
- Pre order traversal.
- Post order traversal.
- In order traversal.
- Level order traversal.
- Delete child node.
- Delete parent node.
- Delete nodes greater than a value from a circular doubly linked list.

Problems on Priority Queues – Level 1

- Meeting rooms problem.
- Ugly number.
- Find median from data stream.
- Find the top K frequent elements.
- Find K Pairs with smallest sums.
- Find the Kth smallest element in a sorted matrix.
- Trapping Rain Water.
- Rearrange String k distance apart.
- Sort characters by frequency.
- Solve the maze problem.

Problems on Graphs – Level 1

- Implement Graph data structure.
- Implement BFS - iterative solution.
- Implement BFS - recursive solution.
- Implement DFS - iterative solution.
- Implement DFS - recursive solution.
- Check if given graph is strongly connected or not.
- Check if given graph is strongly connected or not - using DFS.
- Given a graph find the arrival and departure time of its vertices in DFS. Arrival time is the time when the vertex was explored for the first time, and departure time is the time at which all the neighbours are explored and are ready to backtrack.
- Given a directed acyclic graph and a source vertex, find the cost of the shortest path from source vertex to all other vertices present in the graph. If a vertex cannot be reached from given source vertex that distance may be printed as infinite.
- Given an undirected graph, check if the graph is 2 edge connected or not.

Problems on Hashing – Level 1

- Print a binary tree in vertical order.
- Find whether an array is subset of another array.
- Given an array A [] and a number x, check for pair in A [] with sum as x.
- Minimum operation to make all elements equal in array.
- Maximum distance between two occurrences of same element in array.
- Check if a given array contains duplicate elements within k distance from each other.
- Find duplicates in a given array when elements are not limited to a range.
- Most frequent element in an array.
- Smallest subarray with all occurrences of a most frequent element.
- First element occurring k times in an array.

Problems on Graphs – Level 2

- Find the shortest graph distances between every pair vertex in a given path. Assume that the graph does not have any negative edges.
- Find the shortest graph distances between every pair of vertices in a given path. The graph can have negative edges.
- Detect cycle in DFS.
- Count the number of connected components of a graph represented in the adjacent matrix.
- Count the number of connected components of a graph represented in the adjacent matrix - using DFS.
- Find a spanning tree - not necessarily a minimum spanning tree.
- Detect cycle in an undirected graph.
- Given an undirected graph, find its depth.
- Determine if a directed graph has a unique topological ordering.
- Given a directed acyclic graph and two vertices v and w, find the lowest common ancestor.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1.	Explore the organization of several ADTs and the manipulation (searching, insertion, deletion, traversing) of data stored in various data structures.	Apply	1,2	1
2.	Apply different data structures to solve a given problem.	Apply	1,2	1
3.	Analyze the efficiency of using different data structures and choose the efficient data structure for solving a given problem.	Analyze	1,2	2
4.	Develop new algorithms to solve various problems.	Create	1,2	3,4

TEXT BOOKS:

1. Reema Thareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

Source: https://onlineshop.tees.ac.uk/product-catalogue/school-of-computing-engineering-digital-technologies/distance-learning-tuole/hnd-chemical-engineering/core-modules-level-4-chemical-engineering/fluid-mechanics-15-credits-hnd-chemical-engineering-hghndol

22FT205 FUNDAMENTALS OF FLUID MECHANICS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Physics.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the fundamentals of fluid statics, dynamics, compressible and incompressible fluids, fluidization, transportation and metering of fluids. The objective of this course is to train students on the basic concepts of fluid flow and its application to food process industries.

MODULE-1

UNIT-1 **10L+0T+0P =10 Hours**

INTRODUCTION TO FLUIDS:

Units and dimensions; Properties of fluids; Pressure head of liquid; Compressible and non-compressible fluids; Pressure measuring devices - Piezometer, simple manometer, inclined manometer, differential manometer.

UNIT-2 **6L+0T+16P=22Hours**

KINEMATICS OF FLUID FLOW:

Classification of flows - Steady, unsteady, uniform, non-uniform, laminar and turbulent; Continuity of fluid flow; Boundary layer; Fully developed flow; Bernoulli's theorem; Venturi meter; Orifice meter; Pitot tube; Rotameter.

PRACTICES:

- Identification of laminar and turbulent flows
- Verification of Bernoulli's Equation
- Measurement of flowing fluid using venturi meter
- Measurement of flowing fluid using orifice meter
- Determination of friction loss in flow through pipes

MODULE-2

UNIT-1 **12L+0T +0P=12Hours**

FLOW-THROUGH PIPES AND ORIFICES:

Types of orifices; Hydraulic coefficients; Experimental method for determination of hydraulic coefficients; Different discharges - discharge through a rectangular orifice, discharge over a triangular notch, stepped notch; Dimensional Analysis-Buckingham's pi theorem; Concept of geometric, kinematic and dynamic similarity.

UNIT-2 **4L+0T +16P=20 Hours**

DESIGN OF PIPES AND PUMPS:

Pipes; Fittings; Valves; Pumps; Developed head and power requirement in pumps; Suction lift; Cavitation; Reciprocating pump; Centrifugal pump; Fans; Blowers; Compressors.

PRACTICES:

- Determination of pressure drop in fluidized bed/packed bed
- Determination of characteristics of centrifugal/ reciprocating pump
- Determination of head loss due to sudden expansion/sudden contraction
- Determination of coefficient of discharge of V-notch
- Determination of hydraulic coefficients for an orifice

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand basic principles of fluid mechanics.	Apply	1,2	1,2,3,4
2	Analyze fluid flow problems with the application of the momentum and energy equations.	Apply	1	1,2,3,4,5,7
3	Design the fluid machinery like pumps, compressors.	Apply	1	1,2,8,6
4	Design of fluidized bed reactor.	Apply	1,2	3,4,5,7,
5	Investigate dimensionless groups by dimensional analysis.	Evaluate	2	2,3,4,8

TEXT BOOKS:

1. P. N. Modi and S. M. Seth, “Hydraulics and Fluid Mechanics”, 14th edition, Standard Publishers, 2002.
2. R. K. Bansal, “A Text Book of Fluid Mechanics and Hydraulic Machinery”, 1st edition, Laxmi Publications Pvt. Ltd, 2002.

REFERENCE BOOKS:

1. J. M. Cimbala, Y. A. Cengel, “Fluid Mechanics: Fundamentals and Applications”, 4th edition, McGraw-Hill, 2019.
2. R. J. Grade, “Fluid Mechanics through Problems”, 1st edition, Wiley Eastern Ltd, 1992.

SKILLS:

- ✓ *Analyze fluid flow situations for type of flow.*
- ✓ *Prescribe conditions for maintaining a given type of flow.*
- ✓ *Determine the velocity and pressure drop of fluid flowing through pipes.*
- ✓ *Select a meter for measuring flow rate and velocity of a flowing fluid.*
- ✓ *To select the pump for a given engineering application.*

Source: https://foodmicrobiology.academy/2021/06/20/concepts-of-food-microbiology/

22FT201 FOOD MICROBIOLOGY

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Fundamentals of food microbiology, role, and importance of microorganisms, methods to identify microorganisms.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basics of food microbiology, preservation and spoilage of various food products. The objective of this course is to enable students to apply, identify and enumerate techniques of microbes found in food products.

MODULE-1

UNIT-1 **20L+0T +0P=20 Hours**

INTRODUCTION TO FOOD MICROBIOLOGY:

Fundamentals of food microbiology: History of food microbiology; Classification and morphological characteristics of Fungi, Bacteria; Microbial Growth- factor affecting, Growth curve; Food spoilage and Contamination-Causes; responsible microorganisms.

Food-borne diseases: Infections and diseases caused by the ingestion of pathogenic and non-pathogenic microbes like Staphylococcus, Salmonella, Shigella, E. coli, Bacillus, clostridium,

UNIT-2 **4L+0T +16P=20 Hours**

IDENTIFICATION OF DIFFERENT MICROORGANISMS:

Media preparation, sterilization; plating techniques; incubation, colony counting

PRACTICES:

- Gram staining and microscopic examination of bacteria.
- Techniques of pure culture (Pour plate, spread plate and streak plate).
- Determination of microbial load in food samples.
- Determination yeast and mold count in foods.
- Determination E. coli in foods.
- To perform MBRT for milk.

MODULE-2

UNIT-1 **16L+0T+0P=16 Hours**

ROLE OF BENEFICIAL MICROBES IN FOOD INDUSTRIES:

Food Fermentation: Microorganisms used in Food industry- dairy, fruits and vegetables, cereals and pulses; Single cell protein; Probiotics, Production of industrially important products- amino acids, enzymes, antibiotics, dextran, pullulans, lactic acid, citric acid, ethanol.

UNIT-2 **8L+0T +16P=24 Hours**

APPLICATION OF FOOD FERMENTATION:

Preparation of fermented foods from cereals and pulses; Fermented dairy products (curd, yoghurt); Fermented vegetables, Fermented beverages (wine); Oriental foods.

PRACTICES:

- Preparation of traditional fermented foods: idli, dhokla and Khaman
- Preparation of fermented dairy products: yogurt, curd
- Preparation of fermented vegetables: sauerkraut, pickles
- Preparation of alcoholic beverages: wine
- Preparation and studies on oriental foods like tofu, temph,
- Preparation and studies on soy sauce.

SKILLS:

- ✓ *Prepare and sterilize media.*
- ✓ *Identify types of microorganisms present in food products.*
- ✓ *Prepare pure cultures of microbes.*
- ✓ *Isolate microorganisms from the food sample.*

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of morphology and staining techniques to identify various micro-organisms.	Apply	1	1,2
2	Design preservation conditions based on various intrinsic and extrinsic properties of food.	Apply	2	1,2,34,5
3	Use the principle of canning to avoid spoilage by pathogenic bacteria.	Apply	1,2	1,2,4
4	Developing fermented food and applying beneficial microbes' potential for health promotion.	Apply	1,2	3,1,4
5	Analyze the cause of food spoilage and formulate a list of precautions to avoid spoilage.	Analyze	1	1,2,3,4
6	Investigate the impact of environmental hurdles to control microbial growth.	Analyze	2	1,2,3,4,7

TEXT BOOKS:

1. W. C. Frazier and D. C. Westhoff, “Food Microbiology”, 5th edition, Tata McGraw Hills Publishing Company Limited, 2017.
2. J. M. Jay, “Modern Food Microbiology”, 4th edition, Springer, 2012.

REFERENCE BOOKS:

1. J. Garbutt, “Essentials of Food Microbiology”, 2nd edition, Taylor and Francis, 1997.
2. M. J. Pelczar, E. C. S. Chan and N. R. Krieg, “Microbiology”, 5th edition, Tata McGraw-Hill Education Pvt. Ltd, 1998.
3. S.J. Forsythe, “Microbiology of Safe Food”, 3rd edition, Blackwell Publishing Limited, 2020.

Source: https://greentumble.com/how-to-preserve-food-for-years/

22FT202 PRINCIPLES OF FOOD PRESERVATION AND PROCESSING

Hours Per Week :

L	T	P	C
3	-	2	**4**

PREREQUISITE KNOWLEDGE: Basics of food preservation, classification, application, advantages and limitations.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basic principles involved in food preservation methods. The objective of this course is to provide students with the knowledge of basic food preservation principles and processing methods to control food spoilage and deterioration.

MODULE–1

UNIT-1 **20L+0T +0P=20 Hours**

FOOD PROCESSING AND PRESERVATION:

Introduction to food preservation techniques: History, Scope and principles of food preservation; Preservation Methods- preservation by low temperature- processing, mechanism, refrigeration, chilling, freezing, freezing curve, changes occurring during freezing, types of freezing, thawing, and its effects.

Preservation by high temperature: Different thermal operations-sterilization, pasteurization, blanching, and UHT processing; Canning- different unit operations involved, canning equipment, types of canning containers; Thermal destruction of Microorganisms – D value, F- value, Z-value.

Chemical food preservation: Types of chemical preservatives used to preserve the food and its functions; Permissible limits and safety aspects of using chemical preservatives.

UNIT-2 **4L+0T +16P=20 Hours**

APPLICATION OF FOOD PRESERVATION:

Membrane Processing: General principles and advantages, dead end and cross flow, Classification of membrane system: Reverse Osmosis, Nano Filtration, Ultra Filtration, Micro Filtration, Electo-dialysis and Pervaporation.

PRACTICES:

- To study the Physico-chemical properties of refrigerated and frozen foods.
- Study on importance and principles of food pasteurization.
- Study on importance and principles of food autoclaving.
- Study on importance and principles of food blanching.
- To understand the role of sodium benzoate and potassium sorbate in preserving the beverages.
- Case studies on thermal destruction of microorganisms: D, F and Z- value.

MODULE-2

UNIT-1 **20L+0T +0P=20 Hours**

NOVEL FOOD PROCESSING TECHNIQUES:

Introduction: Irradiation, microwave, radio-frequency, high-pressure processing, pulsed electric field, hurdle technology, ohmic heating, membrane processing, cold plasma.

UNIT-2 **4L+0T +16P=20Hours**

APPLICATION OF NOVEL FOOD PROCESSING TECHNIQUES IN FOOD PRESERVATION:

Food preservation by natural antimicrobials agents from plant, modified-atmosphere packaging, vacuum packaging aseptic processing, ultrasound.

PRACTICES:

- Application of thermosonication in food preservation.
- Study the importance and principles of membrane processing.
- Application of microwave heating in food preservation.
- Study the importance and principle of hurdle technology in food preservation.
- Application of ohmic heating in food preservation.
- Preservation of food by using additives.

SKILLS:

- ✓ *Identify appropriate processing and preservation methods for a given food.*
- ✓ *Identify and suggest suitable food additives for a given food product.*
- ✓ *Troubleshoot problems related to food safety during food processing.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various physical, chemical and biological methods of food preservation to extend the shelf life of food.	Apply	1,2	1,2,3,4
2	Use the principle of low-temperature preservation to avoid food spoilage.	Apply	1	1,2,3,4,5
3	Identify chemical preservatives and their safe usage limit.	Apply	1,2	4,5,7
4	Apply the knowledge of various non-thermal processing techniques for food preservation.	Apply	1,2	1,2,4,5,7
5	Investigate the impact of various types of thermal processing on food preservation and analyze thermal sterilization kinetics.	Analyze	1	1,2,8
6	Formulate thermal process conditions to attain sterility and ensure safe food.	Create	1	2,3,4,8

TEXT BOOKS:

1. Physical Principles of Food Preservation: Revised and Expanded, 2nd edition, Marcus Karel, Daryl B. Lund, 2008.
2. J. P. Fellows, “Food Processing Technology, Principles and Practices”, 5th edition, Wood Head Publishing, 2022.
3. N. N. Potter and J. H. Hotchkiss, “Food Science,” 5th edition, Springer, 2012

REFERENCE BOOKS:

1. H. Ramaswamy, M. Marcotte, “Food Processing: Principles and Applications” Hardcover, Import, 2005.
2. B. Lal, G. B. Siddappa and G. N. Tandon, “Preservation of Fruits and Vegetables,” ICAR Publication, 2009.
3. B. Sivasankar, “Food Processing and Preservation”,2nd edition, PHI Learning Pvt. Ltd., 2002.

https://www.physics236.com/2021/10/thermodynamics-involved-in-cooking-food.html

22FT203 ENGINEERING THERMODYNAMICS

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Basic mathematics.

COURSE DESCRIPTION AND OBJECTIVES:

This course aims to connect the principles, concepts, and laws of classical and statistical thermodynamics to applications that require quantitative knowledge of thermodynamic properties from a macroscopic to a molecular level. The objective of this course is to train the students how to apply knowledge of the laws of thermodynamics, chemistry, physics, and engineering to analyze and solve physical and chemical problems encountered in chemical engineering.

MODULE-1

UNIT-1 **6L+10T+0P=16 Hours**

BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS:

Continuum and macroscopic approach; Thermodynamic systems; Thermodynamic equilibrium and properties; State of a system; Paths and processes on state diagrams; Reversible and irreversible processes; Concepts of heat and work; Zeroth law of thermodynamics; Concept of temperature; Energy - various forms of energy; Specific heats; First law of thermodynamics; Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-v-T behaviour of simple compressible substances, phase rule; ideal and real gases; Equations of state.

UNIT-2 **10L+6T+0P=16 Hours**

APPLICATIONS OF THERMODYNAMIC PRINCIPLES:

Different modes of work transfer; Analysis of first law of thermodynamics - closed systems and control volumes, steady and unsteady flow analysis; Thermodynamic property tables and charts; Van der Waals equation of state; Law of corresponding states; Compressibility factor and generalized compressibility factors and chart.

MODULE-2

UNIT-1 **6L+10T+0P=16 Hours**

SECOND LAW OF THERMODYNAMICS AND ITS APPLICATIONS:

Limitations of the first law of thermodynamics; Kelvin-Planck and Clausius statements and their equivalence; Heat engines and heat pumps/refrigerators; Carnot cycle and Carnot principles/theorems; Thermodynamic temperature scale; Clausius inequality and concept of entropy; Microscopic interpretation of entropy; Principle of increase of entropy; T-S diagrams; Joule-Thomson coefficient; Coefficient of volume expansion; Adiabatic and isothermal compressibility; Clapeyron and Clapeyron-Clausius equations; Third law of thermodynamics.

UNIT-2 **10L+6T+0P=16 Hours**

SECOND LAW APPLICATIONS:

Second law analysis of control volume; Availability and irreversibility; T-dS relations; Carnot vapor cycle; Ideal Rankine cycle; Rankine reheat cycle; Air-standard Otto cycle; Air-standard Diesel cycle, Air-standard Brayton cycle, Vapor-compression refrigeration cycle; Absorption refrigeration; Helmholtz and Gibbs functions; Gibbs relations; Maxwell relations.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply fundamental concepts of thermodynamics to engineering applications	Apply	1	1,2
2	Derive and discuss the first and second laws of thermodynamics.	Apply	2	4
3	Apply laws of thermodynamics to engineering applications.	Apply	1,2	6
4	Analyse problems using the properties and relationships of thermodynamic fluids	Analyse	2	3,4
5	Evaluate thermodynamic properties of substances in gas and liquid states	Evaluate	1	3

SKILLS:

- ✓ *Estimation of thermodynamic properties.*
- ✓ *Determination of heat engine and pump efficiency.*
- ✓ *Identification of reversible and irreversible processes.*
- ✓ *Selection of refrigeration process and refrigerant.*
- ✓ *Describe the process in terms of the changes in system properties*

TEXT BOOKS:

1. J. M. Smith, H. C. Vanness and M. M. Abbot, “Introduction to Chemical Engineering Thermodynamics”, 6th edition, McGraw-Hill, 2005.
2. Y. V. C. Rao, “Chemical Engineering Thermodynamics”, 1st edition, Universities Press, 2004.

REFERENCE BOOKS:

1. Dodge B. F., “Chemical Engineering Thermodynamics”, 1st edition, McGraw-Hill, 1944.
2. Kyle B. G., “Chemical and Process Thermodynamics”, 1st edition, Prentice Hall of India, 1999.
3. P. K. Nag., “Engineering Thermodynamics”, 6th Edition, McGraw Hill, 2017.

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

22TP203 ADVANCED CODING COMPETENCY

Hours Per Week :

L	T	P	C
-	-	2	1

PREREQUISITE KNOWLEDGE: Programming in C, Data Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to understand the impact of the choice of data structures and design strategies to solve the problem in an efficient manner. This course also provides the understanding of advanced graph applications and also throw light in tractable intractable problems.

MODULE-1

UNIT-1 **0L+0T+8P =8 Hours**

STACKS, QUEUES AND SINGLE LINKED LISTS:

PRACTICES:

Problems On Stacks & Queues

- Check if given stack of integers are consecutive or not (could be ascending or descending).
- Find the maximum sum in a sliding window using queues.
- Given a queue of integers, rearrange the elements by interleaving the first half with the second half.
- Given an integer k and a queue of integers, reverse the order of the first k elements of the queue.
- Given a maze in the form of a rectangular matrix filled with O, X or M where O represents an open cell, X represents a blocked cell and M represents landmines, find the shortest distance of every open cell in the maze from its nearest mine.
- For a given parenthesis expression, check whether it is balanced parenthesis or not.
- Reverse a number using stack.
- You are given a string s consisting of lowercase English letters. A duplicate removal consists of choosing two adjacent and equal letters and removing them. We repeatedly make duplicate removals on s until we no longer can.
- Find first Unique character in a string (Queue).
- Implement Tower of Hanoi problem.

Problems On Linked Lists

- Given a random pointer to a random node in a singly linked list, clone the list.
- Given a list rotate the list to the right by k places.
- Remove duplicates from a sorted list.
- Find fractional node in a singly linked list.
- Sort a linked list using constant space complexity.
- Delete a node in start, middle, end of Singly linked list.
- Add a node in start, middle, end of Singly linked list.
- Find whether given single linked list is circular or not.
- Arrange a singly linked list in Descending order.
- Addition of two numbers using Singly Linked List.

UNIT-2 **0L+0T+8P =8 Hours**

DOUBLY LINKED LISTS, CIRCULAR LINKED LISTS:

PRACTICES:

Problems on Double Linked Lists and Circular Linked Lists

- Implement a clockwise rotation of a doubly linked list by N places.
- Count triplets in a sorted doubly linked list whose product is equal to a given value x.
- Find the product of all prime nodes in a doubly linked list.
- Find the count of common nodes in two doubly linked lists.
- Find pairs with given product in a sorted doubly linked list.
- Delete all the even nodes of a circular singly linked list.
- Count nodes in a circular linked list.
- Delete all prime nodes from a circular singly linked list.
- Exchange first and last nodes in a circular linked list.
- Reverse a doubly circular linked list.
- Linear search using a stack of incomplete sub problems.
- 1 2 3 4 5 6 in stack S is push X is pop, SSSSXXSSSXXX.
- Recursively remove all adjacent duplicates.
- Check if a given singly linked list is a palindrome using stack.
- Convert a multilevel singly linked list to a singly linked list.
- Remove duplicates from an unsorted doubly linked list.
- Sort a doubly linked list using insertion sort.
- Check if a doubly linked list of characters is palindrome or not.
- Swap Kth node from beginning with Kth node from end in a Double Linked List.
- Convert a Binary Tree into Double Linked List.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

MODULE-2

UNIT-1 **0L+0T+8P =8 Hours**

TREES:

PRACTICES:

Problems on Trees

- Given a sorted doubly linked list, convert it into a balanced BST.
- Given a singly linked list with data in the ascending order, convert it into a height balanced BST.
- Print the leaf to root path for every leaf node in a binary tree.
- Write a function to implement the reversed level order traversal of a binary tree.
- Truncate a given binary tree to remove nodes that lie on a path having sum less than K.
- Find the vertical sum in a given binary tree.
- Delete minimum & Maximum element from a BST.
- Implement Inorder, preorder and postorder tree traversal techniques.
- Print Kth largest element in a BST.
- Implement Zig-Zag tree traversal.

UNIT-2 **0L+0T+8P =8 Hours**

GRAPHS:

PRACTICES:

Problems on Graphs

- Given a directed acyclic graph, determine whether there is a path that visits every vertex exactly once.
- Reverse a directed graph such that each edge from v to w is replaced by an edge from w to v.
- Find the shortest path in a graph that visits each vertex at least once, starting and ending at the same vertex.
- Find the minimum number of throws required to win a snake and ladder game.
- Implement DFS of a Graph.
- Implement BFS of a Graph.
- Detect whether a cycle is present in an undirected graph.
- Detect cycle in a Directed Graph.
- Find Shortest Distance to goal node from root node in a graph.
- Find no. of nodes in Kth level of a Graph.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various data structures to solve a different algorithm.	Apply	1,2	1
2	Investigate the various data structures to solve a given problem in an efficient manner.	Analyse	1,2	2
3	Design and implement an appropriate hashing function for an application.	Create	1,2	4

TEXT BOOKS:

1. Reema Thareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

22TP204 PROFESSIONAL COMMUNICATION LABORATORY

Source: https://www.coursera.org/specializations/improve-english

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: High School-level English.

COURSE DESCRIPTION AND OBJECTIVES:

To improve the overall professional communication skills (LSRW) of students and prepare them for their profession as engineers and managers. To provide them exposure to conventions of corporate communication and training them on how to function in the business world.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

BASICS OF BUSINESS WRITING SKILLS, PRACTICING BUSINESS CORRESPONDENCE AND REPORT WRITING:

Business English Vocabulary: Glossary of most commonly used words (formal and informal usage).

Elements of Technical Writing: Sentence structure, reducing verbosity, arranging ideas logically, building coherence, cohesive devices and transitional words.

Mechanics of Writing: Elementary rules of grammar, choice of diction, elementary principles of composition, matters of form, punctuation, conventions of business communication, language and professional tone, code of conduct (not sending illegal, offensive, disparaging personal remarks or comments) in written business communication.

Business Correspondence: E-mail: nature and scope, e-mail etiquette, clear call for action, common errors in composing e-mails, office communication such as meeting agenda and notice, circular and memo.

Letter-Writing: Formal and informal letters, structure of formal letters, expressions of salutations, different types of letters [such as sales letter, complaint letter, response to the complaint letter (dispute resolution), letter of permission, letter of enquiring, claim letter – letter of apology etc], introductory and concluding paragraphs and clear call for action.

Professional Proposal/Report: Differentiating proposals and reports, Drafting formal business proposals, types of reports such as factual reports, feasibility reports and survey reports, parts of a report (such as title page, declaration, acknowledgements, table of contents, abstract, introduction, findings, conclusion and recommendations).

New Age Corporate Communication Media: Importance of social media communication and Etiquettes, form and structure, sharing texts through Twitter, Whatsapp, instgram etc.

UNIT-2 **0L+0T+8P=8 Hours**

PRACTICING COMMUNICATIVE LANGUAGE IN VARIOUS PROFESSIONAL CONTEXTS:

Speaking: Speaking in business context, assertiveness, politeness, making requests, queries and questions, negotiations, asking for information, offering suggestions, conflict resolution, contacting clients, initiating, addressing delegates (in public), delivering the presentation effectively, telephone etiquettes, delivering seminar/proposal/report effectively, team meeting etiquettes (face to face and conference call), making effective one minute presentations(JAM) and participating in Group Discussions.

PRACTICES:

- Basic grammar practice, framing paragraphs on topics allocated, paraphrasing an article or a video in your own words, finding topic sentences in newspaper articles, finding out new words from a professional viewpoint and understanding the meaning and its usage.

SKILLS:

- ✓ *To enhance listening and spoken abilities of students needed for professional and social success in interpersonal situations, group interactions, and personal and professional presentations.*
- ✓ *Understand and practice specific functions and vocabulary in a business context.*
- ✓ *Produce short business reports, proposals and correspondence.*
- ✓ *Write various business documents through reading techniques.*

- Perusing samples of well-prepared business emails, memo, letter writing and short proposals and reports, students will draft business correspondence writing tasks and different proposals/ reports on topics assigned.
- Watching videos/listening to audios of business presentations, classroom activities of team and individual presentations, using PPTs, mock exercises for BEC speaking, agreeing, disagreeing politely, developing content, extended speaking in Group Discussion(s).

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

READING AND COMPREHENDING BUSINESS DOCUMENTS:

Reading: Reading and comprehending business documents, learning business register, regularizing the habit of reading business news, suitable vocabulary, skimming and scanning a text for effective and speedy reading and dealing with ideas from different sectors of corporate world in different business contexts.

UNIT-2 **0L+0T+8P=8 Hours**

IMPARTING AND PRACTICING LISTENING SKILLS:

Listening: Specific information in business context, listening to telephonic conversations / messages and understanding the correct intended meaning, understanding the questions asked in interviews or in professional settings, summarizing speaker's opinion or suggestion, enable active listening.

PRACTICES:

- Hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choices, using right vocabulary as per the given context and editing a paragraph.
- Working out BEC/TOEFL/IELTS listening exercises with hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choice- multiple choices, using right vocabulary in context-editing a paragraph, listening to a long conversation such as an interview and answer MCQ s based upon listening.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Possess comprehensive skills in listening and reading business texts in formal context.	Apply	2	7
2	Communicate effectively both in their academic as well as professional environment.	Apply	2 &1	10
3	Clear grasp on the register of business language.	Analyze	1	8
4	Possess the ability to write business reports and proposals clearly and precisely to succeed in their future.	Create	1	12
5	Make effective presentations and participate in formal context.	Create	2	10

TEXT BOOK:

1. S. Schnurr, "Exploring Professional Communication: Language in Action", London: Routledge, 2013

REFERENCE BOOKS:

1. Brook Hart Guy, "Cambridge English Business Bench Mark: Upper Intermediate", 2nd Edition: CUP, 2014.
2. Cambridge University Publication, "Cambridge: BEC VANTAGE Practice Papers", CUP, 2002.
3. J. Seely, "The Oxford Guide to Effective Writing and Speaking", Oxford University Press, 2005.

22FT204 FRUITS AND VEGETABLES PROCESSING

https://nuffoodsspectrum.in/2022/01/10/foodtech-pathshala-announces-virtual-factory-visit.html

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Food preservation methods.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with technologies related to handling, processing and storage of fruits and vegetables. Impart skill and knowledge required to apply the principles and concepts behind fruit and vegetable processing including post-harvest handling.

MODULE-1

UNIT-1 **20L+0T+0P=20 Hours**

INTRODUCTION TO FOOD PRESERVATION TECHNIQUES:

Current status of production and processing of fruits and vegetables; Chemical composition; Pre and postharvest changes; Role of plant growth regulators in relation to storage; Maturity standards for storage, and desirable characteristics of fruits and vegetables for processing; Conditions for transportation and storage; Post-harvest physiology.

UNIT-2 **4L+0T+16P=20 Hours**

APPLICATION OF FOOD PRESERVATION:

Fruit Beverages: Juice, Pulp, RTS, Squash, Nectar, Cordial, Syrup, and Extract),

Jam, Jelly, Marmalade: Pectin- structure, properties and role; Determination of end point; Defects in Jam, jelly Marmalade;

Canning: Blanching and bottling (oven dry pack, oven wet pack, slow water bath, fast water bath and pressure bottling), retorting.

PRACTICES:

- Determination of quality parameters of different fruits and vegetables processed products.
- Determination of sugar acid ratio in fruits and vegetables.
- Determination of pectin content in fruits and vegetables.
- Preparation of jam and determination of TSS and viscosity. (FSSAI Standards)
- Preparation of jelly and marmalade and determination of TSS and viscosity. (FSSAI Standards).
- Testing the adequacy of blanching.
- Clarification of juices with enzymes.

MODULE-2

UNIT-1 **20L+0T +0P=20Hours**

MINIMALLY PROCESSED FRUITS AND VEGETABLES:

Minimally processed fruits and vegetables: Factors affecting shelf life and the quality of minimally processed fruits and vegetables; Physiology and biochemistry of fresh cut; Preservation by freezing - general methods for freezing of fruits and vegetables, problem relating to storage of frozen products, standards for frozen fruits and vegetables; Dehydration of fruits and vegetables – methods of drying; Packaging (CA and MA storage).

SKILLS:

- ✓ *Specify physiological, physical, chemical and nutritional properties of fruits and vegetables.*
- ✓ *Identify and overcome undesirable changes occurred during fruits and vegetables processing.*
- ✓ *Identify the post-harvest factors that effect on shelf life of fruits and vegetables.*
- ✓ *Suggest suitable processing and storage conditions for fruit and vegetable products.*

UNIT-2 **4L+0T +16P = 20Hours**

FERMENTED FRUITS AND VEGETABLE PRODUCTS:

Fermented fruits and vegetable products: Vinegar - production, its uses and quality control checks. Pickle and chutney processing: Role of lactic acid bacteria in pickling with vinegar and fermentation, sauerkraut, kimchi.

PRACTICES:

- Preparation of pickles, chutneys and their quality and cost evaluation.
- Preparation of tomato products and their quality and cost evaluation.
- Preparation of fruit leather and its quality and cost evaluation.
- Alcoholic beverage preparation.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge on processing of fruits and vegetables.	Apply	1,2	1,2,3,4
2	Apply the knowledge of thermal processing techniques for preservation of fruit and vegetable products.	Apply	1	1,2,8,6
3	Analyse the factors affecting the shelf life of minimally processed foods.	Analyze	2	2,3,4,8
4	Develop the preservation techniques to improve the shelf life of seasonal fruits.	Create	1	1,2,3,4,5,7
5	Develop fermented fruits and vegetable food products.	Create	1,2	3,4,5,7

TEXT BOOKS:

1. R. P. Srivastava and S. Kumar, “Fruit and Vegetable Preservation - Principles and Practices”, 3rd edition, International Book Distributors, 2019.
2. B. Lal, G. B. Siddappa and G. N. Tandon, “Preservation of Fruits and Vegetables,” ICAR Publication, 2009.
3. Sharma S. Postharvest Management and Processing of Fruits and Vegetables: Instant Notes. New India Publishing Agency; 2010.

REFERENCE BOOKS:

1. H. Ramaswamy and M. Marcotte, “Food Processing: Principles and Applications” Hardcover, Import, 2005.
2. Potter N. N. and Hotchkiss J. H., “Food Science” 5th e-book edition, CBS Publishers & Distributors Pvt. Ltd. 2021
3. Rachna Sehrawat, Khursheed A. Khan, Megh R. Goyal and Prodyut K. Paul, “Technological Interventions in the Processing of Fruits and Vegetables” 1st edition, Apple Academic Press, 2018.

22FT206 HEAT AND MASS TRANSFER

https://mechanicaljungle.com/tube-in-tube-heat-exchangers/

Hours Per Week :

L	T	P	C
2	2	2	**4**

PREREQUISITE KNOWLEDGE: Basics of physics, integration and differentiation. .

COURSE DESCRIPTION AND OBJECTIVES:

This course deals on imparting fundamental understanding of the phenomena of heat and mass transfer. The objective of this course it to train students on the principles of heat and mass transfer, methodologies for determining rate of heat and mass transfer and perform heat exchanger design calculations.

MODULE–1

UNIT-1 **10L+6T+0P=16 Hours**

BASICS OF MODES OF HEAT TRANSFER:

Modes of Heat Transfer – conduction, convection, radiation; Laws of heat transfer - Fourier's Law, Newton's law of heating or cooling, black body radiation; Steady state heat flow through slab/hallow cylinder/ hallow sphere; Thermal resistance; Overall heat transfer coefficient; Thermal Boundary layer; Dimensional analysis.

UNIT-2 **6L+10T+16P =32 Hours**

APPLICATIONS OF CONDUCTION, CONVECTION AND RADIATION:

Estimation of steady state heat flow through composite slab/cylindrical wall/spherical wall; Dimensional analysis of forced and natural convection; Correlations for natural and forced convection; Estimation of heat transfer coefficient in natural and forced convection; Estimation of rate of heat transfer with conduction and convection; Radiation between black and non-black surfaces.

PRACTICES:

- Determination of thermal conductivity of material.
- Determination of heat transfer through composite wall.
- Determination of heat transfer coefficient in natural and forced convection.
- Determination of emissivity of test plate.

MODULE–2

UNIT-1 **12L+6T+0P=18 Hours**

HEAT, MASS TRANSFER EQUIPMENT:

Heat Exchanger: Classification heat exchangers; Double pipe heat exchanger; Shell and tube heat exchanger; Plate type heat exchanger; Energy balance in heat exchangers; LMTD; General design of heat exchanger.

Boiling heat transfer: Types of boiling; Pool boiling of saturated liquid; Heat transfer coefficient in dropwise and film type condensation; Evaporators- falling film, climbing film, forced circulation and agitated film type evaporators; Economy and capacity of evaporator; Multiple effect evaporator; Methods of feeding; Boilers – fire tube and water tube boilers with examples.

Mass Transfer: Fick's law of diffusion; Mass transfer coefficient; Steady state diffusion through solids; Diffusion through non-diffusing, Equimolar counter diffusion; Mass transfer coefficient; Mass transfer operations – distillation, liquid-liquid extraction, absorption, adsorption.

SKILLS:

- ✓ *Estimate the heat transfer heat transfer coefficient.*
- ✓ *Estimate the rate of heat transfer*
- ✓ *Selection of insulation to reduce the rate of heat transfer*
- ✓ *Design of heat exchanger*
- ✓ *Selection of suitable heat exchanger*
- ✓ *Selection of suitable evaporator*

UNIT-2 **4L+10T+16P=30 Hours**

DESIGN OF HEAT EXCHANGE EQUIPMENT:

Design of double pipe of heat exchanger; Design of shell and tube heat exchanger; Material and energy balance of evaporator; Design of evaporator.

PRACTICES:

- Determination of heat transfer coefficient in double pipe heat exchanger.
- Determination of heat transfer coefficient in shell and tube heat exchanger.
- Determination of critical heat flux.
- Separation of alcohol by using distillation.
- Extraction of caffeine using liquid-liquid extraction.
- Preparation of carbonated water using absorption.
- Removal of impurities from water by Adsorption.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Estimate the heat transfer coefficient and rate of heat	Apply	1,2	1, 2, 3, 4, 9, 10, 12
2	Analyse the performance of a heat exchanger.	Analyze	1,2	1, 2, 3, 4, 5, 9, 10, 12
3	Estimate the rate of mass transfer.	Evaluate	2	1, 2, 3, 4, 9, 10, 12
4	Design a suitable insulation.	Create	1	1, 2, 3, 4, 5, 9, 10, 12
5	Design a suitable heat exchanger.	Create	1,2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. C. J. Geankoplis, “Transport Processes and Unit Operations”, 3rd edition, PHI, 2003.
2. W. L. McCabe, J. C. Smith and P. Harriot. “Unit Operations of Chemical Engineering’, 7th edition, McGraw-Hill, Inc., 2005.

REFERENCE BOOKS:

1. J. P. Holman, S. Bhattacharyya, “Heat Transfer”, 10th edition, McGraw-Hill, Inc., 2017.
2. R. K. Rajput, “Heat and Mass Transfer”, 7th edition, S. Chand, 2020.

22MS201 MANAGEMENT SCIENCE

Source : https://xueqi326.wordpress.com/semester-3/management-science/

Hours Per Week :

L	T	P	C
2	2	-	3

PRE-REQUISITE KNOWLEDGE: Basic knowledge of management

COURSE DESCRIPTION AND OBJECTIVES:

The goal of this course is to analyze theimportance of management, significance of operation management and carry out production operations through work-study. Students will be able to analyse the markets, customers, competitors, and then plan HR function effectively. These management practices, functional areas of the organisation will helps the students to build up their career in the corporate world.

MODULE- 2

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION TO MANAGEMENT:

Concepts of Management and organization- nature, importance and Functions of Management, Systems approach to Management - Taylor's Scientific Management Theory, Fayol's Principles of Management, Mayo's Hawthorne Experiments, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Leadership Styles, Social responsibilities of Management.

UNIT-2 **10L+10T+0P=20 Hours**

OPERATIONS MANAGEMENT:

Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement, Objectives, Need for Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records. Statistical Quality Control: control charts for variables and attributes (simple problems).

PRACTICES:

- Collect some examples with videos for types of production.
- Carry out production operations through work-study
- Practice problems with Inventory control methods and Quality Control charts

MODULE- 2

UNIT-1 **8L+8T+0P=16 Hours**

HUMAN RESOURCES MANAGEMENT:

Concepts of Human Resource Management, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation, and Merit Rating.

UNIT-2 **8L+8T+0P=16 Hours**

MARKETING MANAGEMENT:

Evolution of Marketing, Functions of Marketing Selling Vs Marketing, 4 P's of Marketing – Product Mix - Product Life Cycle – Place Mix – Channels of Distribution – Price Mix – Pricing Methods – Promotion Mix – Tools of Promotions.

SKILLS:

- ✓ *Expert in managerial skills*
- ✓ *Maintain social relations*
- ✓ *Evaluate pricing strategies*

PRACTICES:

- Select any Designation in an organization and try to describe its job description and job specifications.
- How do you deal with grievances at your work.
- Analyze marketing mix in various situations.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Carry out production operations through work-study	Apply	1, 2	1, 2, 3, 5
2	Analyze the nature and importance of management	Analyze	1	1,2,4,6
3	Significance of Operations Management.	Analyze	1, 2	1,2,5
4	Analyze the markets, customers, and competition	Analyze	2	1,2,4,5,6
5	Plan and control the HR function effectively	Evaluate	1, 2	1,2,3,4,5,6

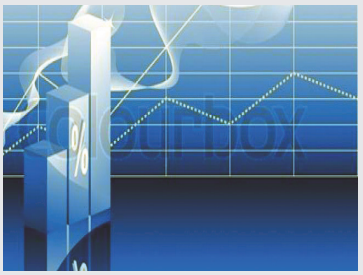
TEXT BOOKS:

1. RajanSaxena: Marketing Management, 4th Edition, TMH, 2013.
2. Dilip Kumar Battacharya, Principles of Management, Pearson, 2012.

REFERENCES :

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy and MithleshwarJha: Marketing Management, 13th Edition, Pearson Education, 2012.
2. Dipak Kumar Bhattacharyya, Production and Operations Management, Universities Press, 2012.
3. Gary Dessler, “Human Resource Management”, 12thEdition, Pearson- 2012.
4. K.Aswathappa, “Human Resource Management”, Text and Cases”, TMH, 2011.
5. Harold Koontz, Heinz Weihrich, A.R. Aryasri, Principles of Management, TMH,2010.

22ST202 PROBABILITY AND STATISTICS



Source: https://images.app.goo.gl/BM6C8TQNTbNWXuA8

Hours Per Week :

L	T	P	C
3	2	-	**4**

PREREQUISITE KNOWLEDGE: Basic knowledge in statistics and mathematics.

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with foundation in elementary topics of statistics and probability such as descriptive statistics, correlation, probability, random variables, correlation, regression, and testing of hypothesis. The course emphasizes statistics to solve engineering and management problems.

MODULE-1

UNIT-1 **12L+8T+0P = 20 Hours**

DESCRIPTIVE STATISTICS:

Basic Definitions, Frequencies, Graphical Representation, Histogram, Ogive curves; Measures of Central tendency, Arithmetic mean, Median, Mode, Mean deviation, Standard deviation; Symmetry and Skewness, Karl Pearson's Coefficient of skewness.

UNIT-2 **12L+8T+0P = 20 Hours**

PROBABILITY AND RANDOM VARIABLES:

Probability: Introduction, Definition (Classical and Axiomatic approach), Addition theorem, Conditional probability, Multiplication theorem and Bayes theorem.

Random Variables: Random variables, Discrete and Continuous variables and distribution function. Expectation, Variance of random Variables, Tchebysher's inequality.

PRACTICES:

- Various graphical presentation techniques.
- Measures of central tendency.
- Skewness.
- Karl Pearson's coefficient of skewness.
- Applications of addition theorem.
- Applications of multiplication theorem.

MODULE - 2

UNIT-1 **12L+0T+8P=20 Hours**

REGRESSION ANALYSIS AND DISTRIBUTIIONS:

Correlation and regression: Correlation, Types, Pearson's and Spearman's Coefficient of correlation, Regression, Regression lines.

Distributions: Introduction to Distributions: Introduction to Distributions: Binomial, Poisson and Normal distributions with properties and applications.

UNIT-2 **12L+0T+8P=20 Hours**

TESTING OF HYPOTHESIS:

Testing large samples- single mean, two means, one proportion and two proportions. Testing small samples –single mean, two means (independent and paired samples), Chi square test-goodness of fit and independence of attributes.

SKILLS:

- ✓ *Collect the data from various data sources and evaluate mean, median, mode mean deviation and standard deviation.*
- ✓ *Identify the areas which we can apply the probability theory.*

PRACTICES:

- Correlation.
- Karl Pearson's coefficient of correlation.
- Regression and regression lines.
- Applications of statistical distributions.
- Testing the large sample tests-one mean and two sample means.
- One proportion and two proportion tests.
- Testing small samples-one, two samples and paired tests.
- Chi-square test for goodness of fit.
- Chi-square test for independence of attributes..

COURSE OUTCOMES:

Upon Successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply measures of central tendency, skewness, and Karl Pearson's coefficient of skewness to study the statistical data sets.	Apply	1	1,2
2	Apply the probability theory and their applications to measure the uncertainty.	Apply	1	1,2
3	Study the relations between statistical variables and can fit the mathematical models for association.	Analyze	2	1,2,3
4	Test the statistical significances for various samples.	Evaluate	2	1,2,4
5	Identify the distribution type to measure the occurrences of chance.	Evaluate	2	1,4,5

TEXT BOOKS:

1. Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.
2. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2012.

REFERENCE BOOKS:

1. P. R. Vittal, "Mathematical Statistics", Margham Publications, Chennai, 2018.
2. Kishore S. Trivedi, "Probability and Statistics with Realiability, Queueing and Computer Science Applications", 2ndedition, Wiley Student edition, 2008.
3. A. Singaravelu, "Probability and Statistics", 22ndedition, Meenakshi Agency, 2015.

III YEAR

B.Tech.

FOOD TECHNOLOGY

COURSE CONTENTS

I SEM & II SEM

I SEMESTER

22TP301	-	Soft Skills Lab
22FT301	-	Cereals, Legumes, Oilseed Process Technology
22FT302	-	Dairy Technology
22FT303	-	Food Processing Operations
22FT304	-	Inter Departmental Project / Course
	-	Department Elective – 2
	-	Open Elective – 2
	-	Industry interface course (Modular course)

II SEMESTER

22TP302	-	Quantitative Aptitude & Logical Reasoning
22FT306	-	Bakery and Confectionery Technology
22FT307	-	Food Packaging
22FT308	-	Inter-Departmental Project/Course
	-	Department Elective – 3
	-	Department Elective – 4
	-	Open Elective – 3

22TP301 SOFT SKILLS LABORATORY

https://choosework.ssa.gov/blog/2019-07-23-soft-skills-an-intro-to-effective-communication

Hours Per Week :

L	T	P	C
-	-	2	1

PREREQUISITE KNOWLEDGE: Grasp on their own academic achievements.

COURSE DESCRIPTION AND OBJECTIVES:

To impart student's employability skills like resume preparation and facing interviews. To enable trainees to develop interpersonal and leadership skills. To train them on work place skills like making presentations, participating in group discussions etc.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

PERSONALITY DEVELOPMENT:

Soft Skills: Need for soft skills, professionalism, employability skills; Communication: Need for effective communication - the process of communication, levels of communication, flow of communication, choice of diction and style with reference to setting (formal, semi-formal or informal); communication networks, barriers to communication, miscommunication, noise and ways to overcome the barriers; Career Planning: Job vs. career, SWOT analysis.

UNIT-2 **0L+0T+8P=8 Hours**

LANGUAGE AND VOCABULARY:

Vocabulary Building: Word etymology, roots, prefixes & suffixes, synonyms & antonyms, collocations, one-word substitutes, analogies, idioms and phrases, contextual guessing of unfamiliar words, task-oriented learning; Reflection of language on Personality, Gender sensitive language in MNCs, Mind your language, Seven essential skills for a team player; attentive listening, intelligent questioning, gently persuading, respecting other's views, assisting others, sharing, participating actively.

PRACTICES:

- Self-Introduction.
- Personal and Academic SWOC.
- Johari Window.
- Giving and taking opinions of Self Vs others and assessing oneself.
- Goal setting.
- Short, Mid and Long Term goals planning the semester.
- Time management: four quadrant system.
- Stephen Covey Time Management Matrix planning a semester.
- Stress-management.
- Questionnaire to assess level of stress.
- 50 words towards resume preparation and interviews.
- Newly coined words.
- Gender sensitive words and Words acceptable in Indian context and objectionable international context.

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

LANGUAGE IN ACTION:

Functional English: Situational dialogues, Role plays (including small talk); Group Discussion: Articulation and flow of oral presentation, dynamics of group discussion, intervention, summarizing and conclusion, voice modulation, content generation, Key Word Approach (KWA), Social, Political, Economic, Legal

SKILLS:

- ✓ *Balance social and emotional intelligence quotients though SWOC, JOHARI etc. activities.*
- ✓ *Prepare tailor made resume and face various job interviews with enriched personality traits.*
- ✓ *Career planning with clear personal and professional goals.*
- ✓ *Solve personal and professional life hiccups with confidence and maturity.*

and Technical Approach (SPELT), View Point of Affected Part (VAP), language relevance, fluency and coherence – 11th and 12th weeks; Resume preparation: Structure and presentation, defining career objective, projecting one's strengths and skill-sets, summarizing, formats and styles and covering letter-Statement of Purpose.

UNIT-2 **0L+0T+8P=8 Hours**

PREPARING FOR PRESENTATIONS AND INTERVIEWS:

Facing Interviews: Interview process, understanding employer expectations, pre-interview planning, opening strategies, impressive self-introduction, answering strategies, other critical aspects such as body language, grooming, other types of interviews such as stress-based interviews, tele- interviews, video interviews, frequently asked questions (FAQs) including behavioral and HR questions and the aspect looked at by corporate during interviews; Presentation Skills: Selection of a topic, preparing an abstract, gathering information, organizing the information, drafting the paper, citing reference sources – writing striking introductions, discussing the methodology used, developing the argument, presentation style, language, presenting the paper and spontaneously answering audience questions.

PRACTICES:

- Opening and closing a telephonic conversation.
- Making an appointment.
- Making a query.
- Offering/Passing on information.
- Communicating with superiors.
- Expressing agreement/objection.
- Opening bank account (combination of prepared and impromptu situations given to each student).
- Group Discussions on various topics.
- Preparing SoP and Resume.
- Mock interviews on the FAQs including feedback.
- Oral presentation with the help of technology (Preparing PPT and presenting).

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mod-ule No.	Mapping with POs
1	Have the ability to introspect on individual strengths and weaknesses, and emerge as a balanced personali-ty with improved self-awareness and self-worth .	Apply	1	12
2	Possess the interpersonal skills to conduct him-self/ herself effectively in everyday professional and social contexts.	Apply	2	8
3	Observe gender sensitive language and workplace etiquette in his professional life.	Analyze	1	9
4	Be able to prepare a resume and gain the confidence to face an interview.	Create	1&2	10
5	Bring professionalism into his/her daily activities.	Create	2	8

TEXT BOOKS:

1. Adrian Furnham, "Personality and intelligence at work", Psychology Press, 2008.
2. S. P. Dhanvel, "English and Soft skills", Orient Blackswan, 2011.

REFERENCE BOOKS:

1. Edward Holffman, "Ace the corporate personality", McGraw Hill, 2001.
2. John Adair Kegan Page, "Leadership for innovation", Kogan, 2007.
3. Krishna Mohan & NP Singh, "Speaking English effectively", Macmillan, 2008.
4. Rajiv K. Mishra, "Personality Development", Rupa & Co. 2004.

22FT301 CEREALS, LEGUMES AND OILSEEDS PROCESSING TECHNOLOGY

https://www.turkishagrinews.com/cereals-pulses-and-oil-seeds-exports-surpass-8-billion-dollars/

Hours Per Week :

L	T	P	C
3	-	2	**4**

PREREQUISITE KNOWLEDGE: Food grains, Germination, Milling, Food Chemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers knowledge on various processing technologies of cereals, legumes and oilseeds. The objective of this course is to make students understand specific aspects related to processing, storage, product formulation and by-product utilization from cereals, legumes and oil seeds.

MODULE-1

UNIT-1 **18L+0T+0P=18 Hours.**

INTRODUCTION OF FOOD GRAINS & DRYERS:

Introduction to grain and grain Dryers: Physico-chemical properties of grains; theory of grain drying, methods of grain drying; Grain dryers - selection, design, and specifications of grain dryers.

Basic properties of Rice: Rice structure, varieties of rice, classification; Parboiling- principles of parboiling of paddy, hydrothermal treatments, conditioning of paddy, physicochemical characteristics.

Basic properties of Wheat: Introduction, varieties, composition and structure; Wheat Milling - flour milling, cleaning, conditioning/hydrothermal treatment, grinding (milling), storage of finished products; Components of a wheat milling equipment: break roll, break sifting system, reduction roll, reduction sifting system, scratch system.

UNIT-2 **6L+0T+16P=22Hours.**

PROCESSING CHARACTERSTICS OF RICE & IT'S HANDLING EQUIPMENTS:

Moisture calculation and drying numerical. Cooking quality of rice; By-products of rice milling and their utilization (rice barn, husk); Storage - aging of rice, quality changes, and processed products based on rice; Rice milling equipment - de-stoner, centrifugal de-husker, rubber-roll sheller, paddy separator, polisher, whitener, rice grader; Baking quality of wheat.

PRACTICES:

- Determination of physical properties of cereals, pulses and oil seeds
- Experiment on dehusking of paddy.
- Experiment on polishing of brown rice.
- Cooking quality of rice and determination of gelatinization temperature.
- Gluten content of flour.
- Alcoholic acidity determination of flour.
- Determination of drying kinetics using lewis model.

MODULE-2

UNIT-1 **15L+0T+0P=15Hours**

INTRODUCTION OF CEREAL, PULSES & OILSEEDS:

Corn Milling: Composition and structure; Corn dry milling and wet milling - tempering, degerming, beall degermer, corn flour, corn flakes, liquid glucose, dextrose powder.

SKILLS:

- ✓ *Determine physico-chemical properties of cereals, pulses and oil seeds.*
- ✓ *Process major cereals and quality analysis of the cereal products.*
- ✓ *Handle cereal processing equipment.*
- ✓ *Extract oil from different oil seeds and quality analysis of oils.*
- ✓ *Identify and suggest appropriate storage conditions for grains.*

Pulse Milling: Classification, composition and structure; Dehulling of pulses - milling methods, traditional and modern milling, CFTRI method, pitting, pulse milling efficiency.

Millets: Importance of Millets-foxtail, finger, pearl millet; Basic properties and products - sorghum constituent, structure of millet milling; Minor millets- Millets constituent.

Processing of Oilseeds: Pre-processing, production and refining oil, vegetable oil; Oilseeds as a non-oil source - oilseed meal as a protein source; Shortening - characteristics, uses, manufacturing process, types of shortening, margarine, mayonnaise, salad oil, peanut butter, vegetable ghee.

UNIT-2 **9L+0T+16P=25Hours**

DEVELOPMENT OF EDIBLE PRODUCT USING CEREAL, PULSES & OILSEEDS:

Different breakfast cereals; Soybean processing - protein isolates, and protein concentrates; Different products of millets-flakes, grits, suji, malts etc. Processing of oilseeds- Mechanical expression-cold, hot and solvent extraction, Vegetable fat based derivatives for food applications, amino acids availability in different oilseed meals; application of oilseed meal

PRACTICES:

- Milling of pulses.
- Determination of peroxide value, iodine value and saponification value of oils.
- Development of new extruded product.
- Development of new product using millets.
- Extraction of soybean protein isolate and concentrates.

COURSE OUTCOMES:

Upon successful completion of this course, students will have to ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of physical properties of food and psychrometric tool to design and develop grain dryers.	Apply	1,2	1, 2, 4, 5, 9, 10, 12
2	Apply the knowledge of dry and wet milling of corn and development of value added products.	Apply	2	1, 2, 5, 9, 10, 12
3	Analyze the method of wheat milling and baking qualities of flour.	Analyze	2	1, 2, 3, 5, 9,
4	Investigate the impact of parboiling/hydrothermal treatment on milling characteristics of rice.	Evaluate	1, 2	1, 2, 5, 9, 10
5	Design and development of processing facilities for sorghum, minor millets and oil seeds.	Create	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. A. Chakraverty, "Post-Harvest Technology of Cereals, Pulses and Oil seeds", 3rd edition, Oxford and IBH Publishing Company Pvt. Limited, 2006.
2. A. Chakraverty, A. S. Mujumdar, G. S. V. Raghavan and H. S. Ramaswamy, "Handbook ofpostharvest technology: cereals, fruits, vegetables, tea, and spices", 2ndedition, MarcelDekker, New York, 2003.

REFERENCE BOOKS :

1. E. V. Araullo, D. B. D. Padua and M. Graham, "Rice- Post Harvest Technology", 1st edition,International Development Research Centre, Canada, 1976.
2. K. Rosentraterand A. Evers, "Kent's Technology of Cereals", 5thedition, Wood headPublishing Co. Ltd., Cambridge, England, 2017.
3. N. Shakuntalamanay and M. Shadaksharaswamy, "Foods - Facts and Principles", 3rdedition, New Age International (P) Ltd. Publishers, New Delhi, 2008.

22FT302 DAIRY TECHNOLOGY

Source: https://www.motherdairy.com/

Hours Per Week :

L	T	P	C
3	-	2	**4**

PREREQUISITE KNOWLEDGE: Microbiology, Food Biochemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with handling, processing and preservation of milk and milk products. The objective of this course is to impart knowledge about milk, milk processing methodologies, processing equipment, by product utilization and to bestow skills.

MODULE–1

UNIT-1 **18L+0T+0P=18 Hours**

MILK, CREAM AND BUTTER:

Milk: Basics properties of milk - milk, composition; Pre-processing of milk - buying and collection of milk, cooling and transportation of milk, Receiving, Preheating, Filtration/Clarification, Cooling, Storage of raw milk; Pasteurization - Definition, Objectives, Methods of pasteurization, Homogenization, Different liquid Milk-Standard, Tonned, Double tonned etc. Sterilized and UHT milk, Bottling, and Storage.

Cream: Definition; Classification; Composition; Factors affecting fat percentage of cream; Defects in cream - causes and prevention.

Butter: Definition: Classification; Composition; Method of manufacture; Packaging and storage of butter; Butter over run; Theories of churning; Continuous butter making; Defects in butter-causes and prevention.

UNIT-2 **6L+0T+16P=22 Hours**

PRACTICAL AND INDUSTRIAL APPLICATION OF MILK PRODUCTS:

Physico-chemical properties of milk; Standardization of milk; Platform test for milk; CIP methods; Detection of common adulterants present in milk; Cream production; Preparation of Butter oil from milk and butter.

PRACTICES:

- Physico-chemical properties of milk.
- Standardization of milk.
- CIP methods.
- Platform test for milk.
- Detection of common adulterants present in milk
- Preparation of Butter oil.

MODULE –2

UNIT-1 **15L+0T+0P=15Hours**

CHEESE, ICE CREAM AND INDIGENOUS MILK PRODUCTS:

Cheese: Method of manufacture; Types of Cheese: Curing of cheese; Defects in cheese -causes and prevention; Whey processing

Dehydrated milk products : WMP, SMP, Infant Milk powders, Malted Milk Foods.

SKILLS:

- ✓ *Determine physico-chemical properties of milk.*
- ✓ *Perform Standardization of milk for different products.*
- ✓ *Proficiency on processing and manufacturing methods of milk and dairy products.*
- ✓ *Identify the milk processing equipment required for a specific application*

Fermented milk: Starter culture – types, propagation and defects.

Indigenous milk products: Khoa: Chhana; Paneer; Srikhand. Ghee

Ice Cream: Definition; Classification; Composition; Nutritive value; Role of constituents in ice cream; Ice-cream Vs Frozen desserts; Method of manufacture; Packaging; Hardening and storage; Over run-in ice cream; Defects - causes and prevention

By-products of dairy industry: Processing of by-products – whey, WPC, WPI, buttermilk, ghee residue; Processing of casein and lactose.

UNIT-2 **9L+0T+16P=25Hours**

RULES AND REGULATION IN DAIRY PRODUCTS AND INDUSTRY:

Preparation and analysis of dairy products-FSSAI standards

PRACTICES:

- Preparation of yoghurt and curd.
- Preparation and analysis of natural butter milk, cultured butter milk, acidophilus milk, Bulgarian butter milk, kumis, kefir.
- Preparation of Special milk - flavored, chocolate, vitaminized/irradiated, and concentrated.
- Preparation of Channa based sweet & Paneer.
- Preparation of Khoa based sweets.
- Preparation of Ice cream.
- Preparation of milk powder by spray drying method.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of separation techniques for production of cream, butter, cheese, ice cream.	Apply	1, 2	1, 2, 5, 9, 10
2	Analyse the composition of milk and identify various processing methods of milk.	Analyze	1,2	1, 2, 4, 5, 9, 10, 12
3	Analyse the nutritional properties of dairy products.	Analyze	2	1, 2, 3, 5, 9,
4	Analyse fermented and unfermented dairy-based beverages and speciality products.	Analyze	2	1, 2, 5, 9, 10, 12
5	Evaluate the properties of various indigenous milk products	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12

TEXT BOOKS:

1. S. De, “Outlines of Dairy Technology”, 1st edition, Oxford University Press, 2019.
2. J. N. Warner, “Principles of Dairy Processing”, 3rd edition, Wiley Eastern Ltd., Delhi, India, 2018.

REFERENCE BOOKS:

1. P. Walstra, “Dairy Science and Technology”, 2nd edition, Taylor & Francis, 2006.
2. Pieter Walstra, “Dairy Technology: Principles of Milk Properties and Processes”, CRC Press, 1999.

22FT303 FOOD PROCESSING OPERATIONS

Source: https://www.flourmiller.com/blog/why-choose-automatic-flour-mill-plant.html

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Food Processing, Properties of food materials.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the principles and practices of multiple unit operations involved in processing industries. The objective of this course is to impart knowledge to students on engineering concepts of unit operations.

MODULE-1

UNIT-1 **8L+8T+8P=24 Hours**

FUNDAMENTALS OF PROPERTIES OF SOLIDS:

Properties, handling and characterization of particulate solids; Properties of particulate masses; Storage and mixing of solids; Mixers for cohesive and non-cohesive solids; Laws of size reduction; Industrial Screening; Effectiveness of screen, Classification of size reduction equipment, Transportation of solid particulate mass.

UNIT-2 **8L+8T+8P=24 Hours**

NUMERICALS AND CASE STUDIES ON PROPERTIES OF SOLIDS:

Estimation of various diameters of the mixture of particles, Estimation of the effectiveness of a screen for separating the oversize and undersize particles, Determination of mixing index, Calculation of power requirements in size reduction, Estimation of efficiency of a crusher in reducing the particles size, Verification of size reduction laws.

PRACTICES:

- Determination of particle size using screen analysis.
- Determination of the effectiveness of a screen.
- Case studies on verification of size reduction laws using jaw crusher.
- Case studies on verification of size reduction laws using ball mill.
- Case studies on finding efficiency of a roll crusher.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

FUNDAMENTALS OF VARIOUS UNIT OPERATIONS:

Classification of filters, Principles of cake filtration, Separation Techniques, Crystallization and Nucleation; Psychrometry - humidification and dehumidification operations; drying theory - thin layer drying, deep bed drying, and types of dryers, Leaching

UNIT-2 **8L+8T+8P=24 Hours**

NUMERICALS AND CASE STUDIES ON VARIOUS UNIT OPERATIONS:

Estimation of Filter medium resistance and Cake resistance in constant pressure filtration, Determination of separating efficiency in separating low density and high density particles using Froth Flotation, Estimation of collection efficiency of high density and low density particles using cyclone separator, Estimation of dehusking efficiency of rubber roll sheller for a given feed.

SKILLS:

- ✓ *Perform cumulative and differential particle size analysis.*
- ✓ *Identify the suitable mixer required for mixing cohesive and non-cohesive solids.*
- ✓ *Recognize the required specifications of the size reduction equipment for a given feed.*
- ✓ *Identify the filtration equipment required for a specific application.*
- ✓ *Compare the efficiency of separation, size reduction, mixing and drying equipment.*

PRACTICES:

- Determination of compressibility coefficient using sedimentation process.
- Determination of filter medium resistance and cake resistance using plate and frame filter press.
- Determination of percent recovery using froth flotation cell.
- Determination of the collection efficiency of a cyclone separator.
- Determination of the dehusking efficiency of rubber roll sheller

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of physical properties of food to design various processing Methods for particulate solids and material handling equipment.	Apply	1,2	1,2,3,4,5,8
2	Design and development of filtration system for separation of suspended solids.	Apply	2	1,2,8,6,9
3	Use of psychrometric tool for solving drying problems and analyse the concept of leaching in food processing.	Apply	1,2	3,4,5,7,
4	To investigate the validity of various laws of size reduction and analyse particle size using screen analysis.	Analyze	1	1,2,3,4,5,7
5	Analyse various agitation and mixing equipment and apply the principle of crystallization for various food application.	Analyze	2	1,2,3,4,8

TEXT BOOKS:

1. R. L. Earle, “Unit Operations in Food Processing”, 2nd edition, Pergamon Press, 2003.
2. W. L.Mc Cabe, J. C. Smith and P. Harriot, “Unit Operations of Chemical Engineering”, 7th edition, McGraw-Hill. Inc., 2005.

REFERENCE BOOKS:

1. J. M. Coulson and J. F. Richardson, “Chemical Engineering” 1st to 5th volume, The Pergamon Press, 1999.
2. K. M. Sahay and K. K. Singh, “Unit Operation of Agricultural Processing”, 2nd edition, Vikas Publishing House Pvt. Ltd, 2004.
3. C.J.Geankoplis, “Transport Process and Unit Operations”, 4th edition, Prentice-Hall of India, 2004.

22TP302 QUANTITATIVE APTITUDE & LOGICAL REASONING

https://images.app.goo.gl/kvtVgA8TkvDCqLhj7

Hours Per Week :

L	T	P	C
1	2	0	2

PREREQUISITE KNOWLEDGE: Basic logical thinking and problem solving ability.

COURSE DESCRIPTION AND OBJECTIVES:

The Students will be introduced to various Arithmetic and Reasoning Problems. The students will have acquaintance with various problems like Time & Work, Time & distance, Percentages, Profit & Loss etc. besides solving puzzles and Critical Reasoning.

MODULE-1

UNIT-1 **4L+8T+0P=12 Hours**

Number system, LCM & HCF of numbers, Percentage, Ratio and Proportion, Profit, Loss and Discount, Average & Mixtures, Simple Interest & Compound interest.

UNIT-2 **4L+8T+0P=12 Hours**

Time and work, Time & distance, Problems on trains, Problems on ages, Permutation & Combinations, Probability.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class.
- Students would have to solve 10 additional problems as a homework assignment in each concept.

MODULE-2

UNIT-1 **4L+8T+0P=12 Hours**

Number series, Letter series, Analogy, Odd man out, Coding and decoding, Syllogisms- Statement & Conclusions, Puzzle test.

UNIT-2 **4L+8T+0P=12 Hours**

Blood relations, Direction sense test, Order & Ranking, Seating Arrangements, Calendar & Clocks.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class. Students would have to solve 10 additional problems as homework assignments in each concept.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Meet the demands of current job market besides equipping them higher studies like CAT, GMAT etc.	Apply	1	2, 5
2	Solve Arithmetic and Reasoning Problems within shortest possible time without paper work.	Apply	1	2, 5
3	Exhibit better analytical skills and aptitude skills.	Analyse	2	2, 4
4	Develop interpretational skills.	Evaluate	2	2, 4

SKILLS:

- ✓ *Helps in developing and improving problem-solving skills.*
- ✓ *Flexing and honing logical abilities.*
- ✓ *Allow students to develop critical thinking skills.*

TEXT BOOKS:

1. R. S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", S. CHAND Publications- Revised Edition, 2017.
2. ARIHANT, "A New Approach to Verbal & Non-Verbal Reasoning", Arihant Publication- Revised Edition, 2021.

REFERENCE BOOKS:

1. Trishna Knowledge Systems, "Quantitative Aptitude for Competitive Examinations", Pearson Publication, 2013.
2. R. S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", Revised Edition, S. CHAND Publications, 2018.

22FT306 BAKERY AND CONFECTIONARY TECHNOLOGY

Source: https://www.bizbuysell.com/bakeries-for-sale/3/

Hours Per Week :

L	T	P	C
3	-	2	**4**

PREREQUISITE KNOWLEDGE: Biochemistry and Nutrition.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with bakery and confectionery sector of food processing. The objective of this course is to acquaint the students with preparation methods for various bakery and confectionary products, quality control aspects, processing parameters and handling of equipment.

MODULE-1

UNIT-1 **18L+0T+0P=18 Hours**

BASIC CONCEPT OF BAKERY:

Global and Indian status of bakery and confectionary industry; Ingredients and their role in bakery industry (wheat flour, sugar, fat and oils, egg, yeast, salt, leavening agents, moistening agent, improvers and emulsifiers); Types of dough developed - developed dough, short dough, semi-sweet, enzyme modified dough; Importance of the consistency of the dough (straight dough, rapid processing, mechanical dough); Breads: Ingredients and process flow of preparation; Types of breads; Various faults in breads – staling of bread, losses during manufacturing; Equipment's used - make up equipment; Functions of mixing and mixer type (horizontal, vertical, planetary and continuous mixers) and blenders used in bakery industry; Divider; Rounder; Moulder; Proofer; Oven; Slicer and packaging materials used; Biscuits and Cookies: Process flow and manufacturing; Biscuits-ingredients and flour specifications; Process flow manufacturing; Types of biscuits and crackers; Faults in biscuits.

UNIT-2 **6L+0T+16P=22 Hours**

ANALYSIS OF BAKERY PRODUCTS:

Physicochemical parameters of bakery ingredients; Rheological testing of dough; Effect of process parameters on quality-biscuit and cookies; Packaging material for biscuits; Gluten free products and pasta - raw material, processing and quality parameters.

PRACTICES:

- Gluten determination of cereal flour.
- Determination of dough raising capacity.
- Water absorption index and solubility test of flour sample.
- Process flow sheet of breads Analysis of quality parameters of developed bread (textural properties, sensory analysis).
- Process flow for different types of biscuits, cookies and crackers.
- Analysis of quality parameters of developed biscuits and cookies (fat, textural properties, sensory analysis)

MODULE-2

UNIT-1 **15L+0T+0P=15 Hours**

CAKE AND CONFECTIONARY PRODUCTS:

Cakes: Ingredients; Flour specification; Process flow and quality evaluation; Faults and corrective measures; Confectionary - Raw materials used in confectionery; Chocolate processing; Miscellaneous products - Co-extruded products; Bakery plant layout; Safe practices in work-place sanitation; Code for hygienic conditions.

SKILLS:

- ✓ *Prepare commonly consumed bakery products like bread and fermented foods,*
- ✓ *Cookies, biscuits, cakes and Icing.*
- ✓ *Judge the quality of raw-materials.*
- ✓ *Predict the physiochemical changes during processing.*
- ✓ *Handling of various bakery equipment.*

UNIT-2 **9L+0T+16P=25 Hours**

PREPARATION AND PROCESSING OF DIFFERENT CONFECTIONARY PRODUCTS:

Sugar confectionery: Processing and quality assessment of cotton candy, fruit drops, centre filled toffees, caramel; lollipops; chewing gums and bubble gums; Preparation and analysis of fudges, lozenges toffees, marshmallow and fondants, 3 D food printing

PRACTICES:

- Preparation and quality analysis of cakes, pastries, doughnuts, Pizza.
- Processing and analysis of chocolate and candy bars.
- Preparation and quality analysis of cakes, doughnuts, Pizza.
- Preparation and analysis of hard-boiled candies, centre filled toffees, caramel.
- 3D printing of confectionery products

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify various ingredients used in bakery and confectionary products	Apply	1	1, 3, 4, 5, 9, 10, 12
2	Analyse the function and interaction of carbohydrate and protein during dough development.	Analyze	1, 2	1, 2, 9, 10
3	Analyse the nutritional properties of value-added bakery and confectionary products.	Analyze	1,2	1, 2, 3, 5, 9, 10
4	Investigate the impact of processing methods on quality of baked and confectionary products.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12
5	Develop suitable method for value added bakery product development.	Create	2	1, 2, 4, 9, 10, 12

TEXT BOOKS:

1. W. J. Sultan,"Baker's Handbook on Practical Baking", 5th edition, US wheat Associates, Wiley, 2010.
2. J. Kingslee, "A Professional Textto Bakery and Confectionery", 3rd edition, New Age International, New Delhi, 2006.

REFERENCE BOOKS:

1. E. B. Jackson, "Sugar Confectionery Manufacture", 2nd edition, Springer, 1995.
2. Ashok kumar Y, "Textbook of Bakery and Confectionery: Second Edition", 2nd edition, Prentice Hall India Learning Private Limited, 2012.
3. Geoff Talbot, "Science and Technology of Enrobed and Filled Chocolate, Confectionery and Bakery Products", Woodhead Publishing Series in Food Science, Technology and Nutrition, 2009.

22FT307 FOOD PACKAGING

Source: https://www.yelu.in/category/food-packaging/city:ahmedabad

Hours Per Week :

L	T	P	C
2	-	2	3

PREREQUISITE KNOWLEDGE: Food Quality, Shelf Life.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with types and functions of packaging material along with its various methods and equipment used for packaging. The objective of this course is to impart knowledge to students on applications of food packaging materials and methods effectively in accordance with relevant standard regulations, environment protection and ethical principles.

MODULE –1

UNIT-1 **12L+0T+0P=12 Hours**

INTRODUCTION TO FOOD PACKAGING AND MATERIALS:

Packaging and packing: Importance and functions of food packaging; Need for packaging; Ideal characteristics of packaging material-selection and rejection criteria for different packaging materials. Primary, secondary and tertiary packaging.

Role of packaging in food industries: Packaging functions, package design consideration; Factors need to be considered to produce successful package - transport hazards, marketing facts and cost considerations.

Packaging requirements: Cereals, meat, poultry, fish, milk, vegetables, fruits, plantation crop-based products and carbonated beverages;

Types of packaging materials: Plastic as packaging material (flexible, hard and laminate) flexible packages, Paper-manufacturing process; tetra pack and spout packing, Metal containers: strength requirement, seaming and coating properties; contamination from lacquers; Glass: containers and closures; Corrosion and toxicity of packaging material.

UNIT-2 **4L+0T+16P=20 Hours**

APPLICATION OF VARIOUS PACKAGING MATERIALS:

Packaging materials - Polymer films–polymers, Physical, Chemical and permeability properties, manufacturing methods, Testing and identification,Permeability Modelling, Migration of chemicals; Paper - applications, Properties and applications of corrugated paperboard on machine and its process.

Testing of Polymers: Rigid, semi rigid and flexible packaging material; Shelf life study.

PRACTICES:

- Identification of the codes used for various plastic materials and types of polymer materials.
- Determination of GSM of packaging materials.
- Determination of bursting strength of packaging materials.
- Determination of tensile strength of packaging materials.
- Determination of WVTR.
- Puncture testing of packaging materials
- Torque testing of packaging materials.
- Determination of COBB Value.
- Determination of edge crush strength of a food package.
- Determination of tearing strength of packaging material.

SKILLS:

- ✓ *Measure and evaluate properties of packaging materials.*
- ✓ *Define the packaging requirements for a given food product.*
- ✓ *Suggest suitable labeling requirements for a food package.*
- ✓ *Suggest packaging material for any given food materials.*

MODULE-2

UNIT-1 **10L+0T+0P=10 Hours**

FOOD PACKAGING MACHINERY IN INDUSTRY:

Machinery for weighing, filling, sealing and wrapping operations; Firm fill-seal (FFS) machines - horizontal FFS machine, its mode of operation for sachet and pouch for different food products, vertical FFS machine, its mode of operation for sachet and pouch for different food products, wrapping, cartooning, labelling, bar-coding, marking and strapping; Packing for physical distribution; Industrial packaging - material handling, cushioning, unit palletizing, stacking and containerization. Environmental aspects; Future trends.

UNIT-2 **6L+0T+16P=22 Hours**

ADVANCED FOOD PACKAGING:

Biodegradable packaging: Edible packaging materials – edible film and edible coatings, waxing

Special packaging: MAP, CAP, vacuum and aseptic packaging; shrink packaging.

Advances in food packaging - Smart packaging, intelligent packaging, active packaging, antimicrobial packaging; Standards of packaging materials according to FSSAI and BIS.

PRACTICES: S

- Development of edible coating for fruits and vegetables.
- Development of edible film for fruits and vegetables.
- Study on vacuum packaging.
- Study on MAP and CAP of fresh fruits and vegetables.
- Industrial tour on canning industry.
- Identification of the standards for labelling and comparison with a sample food product package.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify various methods of food packaging and factors affecting the shelf life of the packaged foods.	Apply	1,2	1, 2, 4, 5,6,7, 12
2	Apply the knowledge of hazards and toxicity associated with packaging and to design safe packaging for food products.	Apply	1	1, 2, 3, 4, 5, 6,7, 8,12
3	Investigate the properties of various packing material.	Analyze	1	1, 2, 3, 4, 6, 7, 8, 9
4	Identify various biodegradable and eco-friendly packaging materials	Evaluate	2	1, 2, 3, 4, 5, 6, 8, 9, 11, 12
5	Formulate labelling information to develop knowledge on laws and regulation involved in safety and labelling of foods.	Create	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. G.L. Robertson, “Food Packaging - Principles and Practices”, 3rdedition, Marcel Dekker, 1992.
2. R. Ahvenainen, “Novel Food Packaging Techniques”, 3rd edition, Blackwell, CRC Press, 2001.

REFERENCE BOOKS:

1. R. Coles, “Food Packaging Technology”, 2nd edition, Blackwell, CRC Press, 2003.
2. N. Khetarpaul and D. Punia, “Food Packaging” 2nd edition, Daya Publishing House, 2003.
3. Rui M.S. Cruz, “Food Packaging: Innovations and Shelf-Life” 1st edition, CRC Press, 2021.

IV

YEAR

FOOD TECHNOLOGY

B.Tech.

I SEMESTER

22FT401	-	Food Plant Layout and Equipment Design
22FT402	-	Food Safety and Quality Management
	-	Department Elective – 5
	-	Department Elective – 6
	-	Department Elective – 7
	-	Department Elective – 8

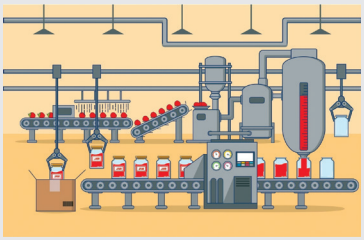
II SEMESTER

22FT403	-	Project Work
22FT404	-	Internship

COURSE CONTENTS

I SEM & II SEM

22FT401 FOOD PLANT LAYOUT AND EQUIPMENT DESIGN



Source: https://www.thomasnet.com/articles/machinery-tools-supplies/overview-of-food-processing-equipment/

Hours Per Week :

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: Food process operations, Heat and mass transfer, Extrusion, and Maintenance of food equipment.

COURSE DESCRIPTION AND OBJECTIVES:

One of the main objectives of the course is to familiarize the students with the fundamental concepts of engineering food process operations and plant layout which will be used as background knowledge for the understanding of specialized courses in the field of Food Technology with prime focus on Plant layout design, plant economics, machine designing for food processing and its cost estimation.

MODULE-1

UNIT-1 **14L+4T+0P=18 Hours**

BASICS FOOD PLANT LAYOUT DESIGN:

Basic concepts of plant layout design including basic understanding of equipment layout ventilation; Location of plant layout: location factors, plant site selection, Location theory and models, industrial buildings and grounds; Process engineering economics-money flow in food business enterprise, capital cost, manufacturing cost, cash flow analysis, plant profitability, sensitivity analysis; Application of program evaluation and review technique (PERT) and critical path method (CPM) in project planning and monitoring.

UNIT-2 **10L+12T+0P=22 Hours**

PLANT LAYOUT DESIGN OF FOOD INDUSTRIES:

Plant layout design with reference to - bakery, fruits and vegetable and dairy industries; miscellaneous aspects of plant layout and design like provision for waste disposal; ISO, FPO, MPO requirements in food plant layout and design; Preparation of flow sheets for material movement and utility consumption in food plants.

PRACTICES:

- Design and organizing the layout of bakery unit.
- Assessment of data forms (i.e., common problems) in Plant Layout and Process (i.e., Line diagrams) scheduling.
- Case studies on equipment selection and capacity determination, arrangement of process, and service equipment for the layout of multi-product and composite food Plants.
- Case studies on waste treatment and management in food processing plants.

MODULE –2

UNIT-1 **12L+2T+0P=14 Hours**

FOOD PROCESS EQUIPMENT DESIGN:

Design considerations of food processing equipment and food processing facilities - materials of construction, strength of materials-compressive strength and tensile strength, factor of safety, theories of failure, allowable stresses, and minimum thickness after forming; Basic principles for hygienic design of various food equipment and auxiliary systems in contact with foods.

SKILLS:

- ✓ *Designing and economic analysis of various food processing industries layouts.*
- ✓ *Design of common equipment used in food processing industries.*
- ✓ *Selection and optimization of operating and performance parameters in different food processing equipment.*
- ✓ *Soft skills related to design and develop of plant and machine in AutoCAD or solid work.*

UNIT-2 **12L+14T+0P=26 Hours**

DESIGN AND DESIGN RELATED PROBLEMS:

Pressure and storage vessels: Operating conditions, design conditions and stress; Design of heat exchangers-shell and tube heat exchanger, plate heat exchanger; Design consideration of material conveying equipment - belt conveyor, screw conveyor, bucket elevator; Sterilizer and retort, Design of evaporators; Design of Dryers-Cabinet/tray and fluidized bed dryer; Design of extruders- Cold and hot extruder design, design of screw and barrel, design of twin screw extruder.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design of various food processing equipment's using construction materials of varied strengths.	Apply	2	1, 2, 5, 9, 10, 12
2	Development of food processing project management skill.	Apply	1	1, 2, 3, 4, 5, 6, 8,12
3	Analysis the hygiene status of various food process equipment and process economics.	Analyze	2	1, 2, 3, 4, 6, 7, 8, 9
4	Asses the implementation of various equipment process flows on the plant layout economics	Analyze	1, 2	1, 2, 3, 5, 6, 7, 9, 10, 11, 12
5	Formulate layout for various type of food processing units.	Create	1	1, 2, 4, 5, 6, 7, 12

TEXT BOOKS:

1. A. Lopez-Geomez and G. V. Barbosa-Canovas, "Food Plant Design", 2nd edition, CRC press, Taylor & Francis, New York, 2000.
2. R. T. Toledo, "Fundamentals of Food Process Engineering", 3rd edition, Springer, 1999.s

REFERENCE BOOKS:

1. M. S. Peter and K. D. Timmerhaus, "Plant Design and Economics for Chemical Engineers", 2nd edition, McGraw Hill, 2001.
2. R. L. Earle., "Unit Operations in Food Processing", 2nd edition, CRC press, 1999. T. Ahmed, "Dairy Plant Engineering and Management", 4th edition, Kitab Mahal, 1997.

22FT402 FOOD SAFETY AND QUALITY MANAGEMENT

Source: https://www.kizytracking.com/fssc-22000-compliance-food-safety-standards/

Hours Per Week :

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: Food Quality, Food Microbiology, Food Toxicology.

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with global food safety, security, Food laws, standards and regulations. The objective of this course is to impart knowledge to students on national and international food standards along with application of ISO and HACCP in food processing industries.

MODULE–1

UNIT-1 **18L+6T+0P=24 Hours**

FOOD SAFETY AND NATIONAL FOOD LAWS:

Introduction to food safety, Food security; Concept of food safety and standards (FSSAI); Licensing and registration (FSSAI); Objectives and functions of FSSAI, Offenses and penalties; Quality control vs quality assurance; AGMARK act and rules - title, definitions, certification procedure, laboratory approvals and action on non-compliance, appeals; BIS - evolution of BIS, scope, definitions, power & functions of BIS, licensing procedure; export and import laws and regulations, export (Quality control and Inspection) act, 1963; APEDA, MPEDA- Introduction, act and rules, function.

UNIT-2 **6L+10T+0P=16 Hours**

FOOD QUALITY:

Quality attributes of food, Gustation: Mechanism of taste perception, Difference tests for sensory evaluation; Olfaction, Color: CIE (International Commission on Illumination) color system; Image processing techniques for Food Quality Evaluation; Texture. Introduction to food safety& standards, Concept of food Hazards- Physical, Chemical and biological, Food adulteration and safety, Permitted Food additives and limits, Statistical Quality Control techniques.

PRACTICES:

- Finding hazards in food product samples: Biological hazards, Chemical hazards, Physical hazards, Trace chemicals.
- Case study on microbiological considerations in food safety.
- HACCP: Identification of CCPs, application of HACCP in food industry.

MODULE–2

UNIT-1 **12L+2T+0P=14 Hours**

INTERNATIONAL FOOD LAWS:

FAO: Overview of Organization structure, Objectives & Functions; Introduction to WHO; Codex Alimentarius commission - role of CAC and its committees; Introduction to OIE and IPPC; Introduction of other international food standards- BRC, Kosher etc. WTO - introduction to WTO agreements, SPS and TBT Agreement; Implications on trade in light of SPS and TBT.

SKILLS:

- ✓ *Apply different coloring matter in developing new food products.*
- ✓ *Preserve food in a synergistic manner using chelating and antioxidants.*
- ✓ *Make use of different thickening agents in modifying the food texture.*
- ✓ *Develop different variety of food products using different flavor on same basic ingredient.*
- ✓ *Determine toxicity level of each food additive.*

UNIT-2 **12L+14T+0P = 26 Hours**

IMPLEMENTATION OF ISO STANDARDS:

Introduction to Contents of the standards, Salient features, Advantages of implementation of the standard, Certification & Auditing; ISO 9001:2008 - evolution of ISO 9001:2008, Introduction to the family of ISO 22000 standards - FSMS – 22000:2005, various elements and clauses included in the standard; Comparison of ISO 9001:2008 vs. ISO 22000:2005.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Formulate the optimal level of food additives for various food applications.	Apply	2	1, 2, 5, 9, 10, 12
2	Analyze knowledge of naturally available food additive for food preservation.	Apply	1	1, 2, 3, 4, 5, 6, 8,12
3	Analyze and identify the food hazards and risk associated with it.	Analyze	1	1, 2, 4, 6, 7
4	Apply the knowledge of food safety protocols to food business operators.	Analyze	2	1, 2, 3, 4, 6, 7, 8, 9
5	Analyze and identify various food additives and their safe usage limits.	Analyze	1, 2	1, 2, 5, 7, 9, 10, 11, 12

TEXT BOOKS:

1. C. A. Roberts, “The Food Safety Information Handbook”, 2nd edition, Oryx Press, 2001.
2. R. H. Schmidt and G. E. Rodrick, “Food Safety Handbook”, 3rd edition, John Wiley & Sons, 2005.

REFERENCE BOOKS:

1. N. Rees and D. Watson, “International standards for food safety”, 1st edition, Aspen publishers, Gaithersburg, Maryland. 2000.
2. P. L. Knechtges, “Food safety: Theory and Practice”, 1st edition, Jones and Bartlett learning, UK, 2012.

DEPT. ELECTIVES

B.Tech.

COURSE CONTENTS

I SEM & II SEM

FOOD TECHNOLOGY

Stream - 1 Food Business Management

- 22FT801 - Food Business Management and Entrepreneurship Development
- 22FT802 - Food Supply Chain Management
- 22FT803 - Production and Operations Management
- 22FT804 - Project Planning Preparation and Management
- 22FT805 - Strategy and Marketing of Food Products

Stream - 2 Food Engineering

- 22FT806 - Bioprocess Engineering
- 22FT807 - Engineering Properties of Food Material
- 22FT808 - Instrumentation and Process Control
- 22FT809 - Maintenance of Food Equipment
- 22FT810 - Refrigeration Engineering and Cold Chain
- 22FT811 - Biosensor Design and Application

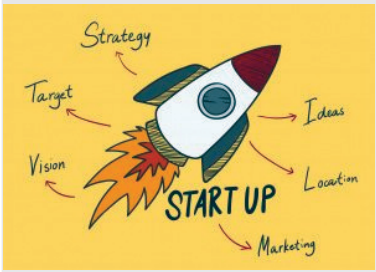
Stream - 3 Food Quality and Assurance

- 22FT812 - Food Quality Assurance and Certification
- 22FT813 - Food Toxicology and Agrochemical Residues in Food
- 22FT814 - Instrumental Methods of Food Analysis
- 22FT815 - Sensory Analysis of Food

Stream - 4 Food Processing Technology

- 22FT816 - Beverage Technology
- 22FT817 - Emerging Trends in Food Processing
- 22FT818 - Extrusion Technology
- 22FT819 - Meat, Fish and Poultry Processing Technology
- 22FT820 - Post-Harvest Management of Fruits and Vegetables
- 22FT821 - Spices and Plantation Crop Process Technology
- 22FT822 - Waste Management and By-Product Utilization

22FT801 FOOD BUSINESS MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT



Source: https://incparadise.net/introduction-entrepreneurship-development/

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Food business management and Food entrepreneurship.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers the framework for improving managerial skills and leadership qualities. The objective of the course is to provide skills related to making decisions, organization structure, production operations, marketing, human resource management, product management and other management strategies.

MODULE –1

UNIT-1 **6L+6T+0P=12 Hours**

BASICS OF FOOD BUSINESS MANAGEMENT AND SCHEDULING:

Project Definitions related to project management and entrepreneurship; Fundamentals of project management and entrepreneurship development; Project identification; Project selection; Project Proposal; Network Scheduling- Activity; networks; Use of CPM; PERT in project scheduling.

UNIT-2 **10L+10T+0P=20 Hours**

PROJECT COST ESTIMATION:

Market Survey Techniques; Work breakdown structure; Estimation of project costs; Earned value analysis; Project techno-economic viability; Break-even analysis; Resource planning; Resource allocation; Project scheduling with limited resources.

PRACTICES:

- Developing the work breakdown structure (WBS)
- Analyzing the schedule
- Task and resource scheduling tools
- Develop strategies and multiple backup plans
- Expert Judgement Method.
- Analogous Estimating Method.
- Parametric Estimating Method.
- Bottom-up Estimating Method.
- Three-Point Estimating Method.
- Data Analysis Method.
- Project Management Information System Method.
- Decision-Making Method

MODULE –2

UNIT-1 **8L+8T+0P=16 Hours**

SCOPE IN THE FOOD PROCESSING SECTOR AND MARKET ASSESSMENT:

Government policies for the promotion of entrepreneurship in food processing; Make in India; Start-up India; Market assessment; Resource mobilization.

SKILLS:

- ✓ *Identify the opportunities in food business.*
- ✓ *Analyze the market demand for new food products.*
- ✓ *Prepare detailed project report.*

UNIT-2 **8L+8T+0P=16 Hours**

LAUNCHING AND ORGANIZING AN ENTERPRISE:

Prime Minister Formalization of Micro Enterprises (PMFME); Enterprise selection; Feasibility study; SWOT analysis; Financial institution in promoting food processing units; Supply chain management.

PRACTICES:

- Government's initiatives to Promote FPI
- Factors influencing Food Processing Industries
- Constraints and challenges to Food Processing Industries
- Sustainability in food processing industry
- Process of Organizing an Enterprise
- Launching and enterprise
- Components of Business and Enterprise SE Capability

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Knowledge on various aspects of Business manage-ment and entrepreneurship development in food processing.	Apply	1	1, 2, 12
2	Analyze strength, weakness, opportunities, threat in relation with food industry.	Apply	1	1, 2, 5, 12
3	Prepare the detailed project report for food pro-cessing business.	Apply	1	1, 2, 3, 5, 12
4	Identify the market trends in food processing and marketing.	Analyze	2	1, 2, 12
5	Identify the different governmental scheme for food processing sector.	Analyze	2	1, 2

TEXT BOOKS:

1. Gail Freeman Bell and James Balkwill, Management and Engineering, Printice Hall International.
2. Lisa Jordan, Food Industry: Food Processing and Management, 2nd edition, Callisto.

REFERENCES BOOKS:

1. Dinesh Awasthi and Rama Jaggi, Entrepreneurship and Management inputs for entrepreneurs in Food Processing Sector, Ahmedabad EDII.
2. C R Bharatia, Food Technology and Entrepreneurship Management, Surendra Publications.

22FT802 FOOD SUPPLY CHAIN MANAGEMENT

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Inventory management, Logistic and retail

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with supply chain of fresh and processed food products and agriculture commodity. The objective of the course is to impart knowledge to students on food supply chain from farm to fork, their quality evaluation, auditing, and certification of foods. This course also provide opportunity to learn management of food products throughout the supply chain.

MODULE - 1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION OF FOOD SUPPLY CHAIN AND INVENTORY MANAGEMENT:

Food Supply Chains; Evolution of food supply chain; Relationship between Food & economy; International Definition of Food Supply Chain; Significance & Drivers; Forces in Food Supply Chain (FSC) -Producers; Processors; Retailers & Distributors; Hospitality Sectors; Consumers; Inventory Management; EOQ and its derivative models; 3rd/4th Party Logistics (3PL/4PL).

UNIT-2 **10L+10T+0P=20 Hours**

LOGISTICS AND STRATEGIC ALLIANCES:

Types of Food Chains factors influencing Food Supply Chain; Food Logistics- Movement of Food; Packaging in Logistics; Temperature Controlled Supply Chains; Managing Uncertainty; Method for Coping with Bullwhip Effect; Supply Chain Integration; Push vs. Pull Systems. Retailer- Supplier Partnerships; Buyer Vendor Coordination.

PRACTICES:

- Evaluate current practices.
- Routine stock reviews.
- Learning customer behaviour
- Optimize stock replenishment.
- Ensure faster product recalls.
- Reduce food waste.
- benefits of logistics planning
- Strategic logistics planning
- Logistics strategies for streamlined fulfillment

MODULE-2

UNIT-1 **8L+8T+0P=16 Hours**

TRANSPORTATION AND SUSTAINABLE FOOD SUPPLY CHAINS:

Management of transportation; Inter model transportation and third-party transportation services; Characteristics of different transportation modes; Distribution strategies; Procurement & Outsourcing Strategies; Challenges; Developing Sustainability within food supply chains- Production; Logistics & Retail; and Sourcing; Food Sector & Economic Regeneration; Strategic considerations for supply chain; Porter's industry analysis and value-chain models.

Source: https://money.howstuffworks.com/food-supply-chain-pandemic.htm

SKILLS:

- ✓ *Prepare quality control charts for a given process.*
- ✓ *HACCP implementation in food industry.*
- ✓ *Auditing in logistics and transportation of food.*

UNIT-2 **8L+8T+0P=16 Hours**

DEVELOPING SUSTAINABILITY WITHIN FOOD SUPPLY CHAINS:

Buy-Make Decision; Procurement Strategy and Framework of e-Procurement attributes to consider when designing food supply chain; Perishability; Seasonality in production; Edible nature of product; Heterogeneity- Info Asymmetry; Logistics Infrastructure; Food Cluster & Enterprise Zone; Food Parks & Hubs.

PRACTICES:

- Challenges in the Food Supply Chain.
- Sustainable Practices in the Food Supply Chain.
- Transportation Collaboration.
- Inventory Tracking and Food Traceability.
- Warehouse Inventory Management Systems.
- Demand Forecasting.
- Improved Supplier Reliability.
- Review Methods for Sustainable Food Supply Chains.
- Best Practices in Regional Food Systems Logistics.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the inventory management process during supply chain.	Apply	1	1, 2, 12
2	Apply sustainability in food supply chain management.	Apply	1	1, 2, 3, 5, 12
3	Analyse quality aspects of food during supply chain.	Analyze	1	1, 2, 5, 12
4	Study overall supply chain structure for food commodities/products.	Analyze	2	1, 2, 12
5	Study sources and purchase mechanism for food commodities/ products.	Analyze	2	1, 2

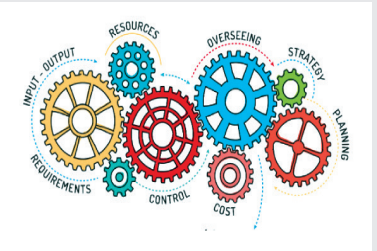
TEXT BOOKS:

1. Food Supply Chain Management & Logistics. (From Farm to Fork) by Mr. Samir Dani, Published by Kogan Page, New Delhi.
2. Food Supply Management (issues for the hospitality and retail sectors)- Edited by Jane F Eastham, Liz Sharples& Stephen D Ball, Published by Butterworth Heinemann, New Delhi.
3. Chopra, S, and P. Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson Education.

REFERENCE BOOKS:

1. Raghuram, G. and N. Rangaraj, Logistics and Supply Chain Management: Cases and Concepts; Macmillan, New Delhi.
2. Simchi-Levi, D., P. Kaminski and E. Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies; Irwin, McGraw-Hill.
3. Shapiro, J., Modelling the Supply Chain; Duxbury Thomson Learning.

22FT803 PRODUCTION AND OPERATIONS MANAGEMENT



Source: https://www.proprofs.com/quiz-school/story.php?title=operations-management-test-1-practice

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Production and operations.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to impart knowledge to students on production and operations in food industries and related filed. This course also provide opportunity to learn production system, planning, distribution and material management throughout the production and operations.

MODULE - I

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION OF PRODUCTION AND OPERATIONS:

Nature and Scope of Production/Operations Management; POM Relationship with other Systems in the Organization; Functions of Production and Material Management; Types of Production Systems; Productivity Variables and Productivity Measurement; Production Planning and Control in Mass Production; Batch Production; Job Order Production.

UNIT-2 **10L+10T+0P=20 Hours**

PRODUCTION SYSTEM AND CAPACITY DESIGN:

Factors that affect System and Concept of Production and Operation Management; Facility Location; Types of Manufacturing Systems; Lean Manufacturing; Student Planning and Analysis; Selection; Product Design and Development; Process Selection; Capacity Design; Determination of Material Required; Procedure for Purchasing; Stocking and Distribution of Materials.

PRACTICES:

- Product strategies, product life cycle, production function
- Forecasting: Methods
- Facilities planning: Site location, facilities layout
- Problems on single facility location using median method
- Time study and work measurement techniques
- Production planning and control- Aggregate planning
- Flow control
- Capacity Planning Classification
- Capacity and Production Planning for a New Product
- Determining Efficiency in Your Operations.

MODULE - 2

UNIT-1 **8L+8T+0P=16 Hours**

SCHEDULING, MEASURING AND MATERIAL MANAGEMENT:

Scheduling; Maintenance Management Concepts; TPM; An overview of Material Management; Material Planning and Inventory Control; Inventory Models; (Classical EOQ; Model with Shortages); JIT; Quality Assurance; Accepting Sampling.

SKILLS:

- ✓ *Production and Operations Management*
- ✓ *Modern Production/Operations Management*
- ✓ *Maintenance Management Concepts*
- ✓ *Total Quality Management*

UNIT-2 **8L+8T+0P=16 Hours**

QUALITY IN PRODUCTION AND PRODUCTION ACTIVITIES:

Work-Study; Method Study; Work Measurement; Work Sampling; Work Environment and Safety; Material Management; Budgeting and Material Planning; Purchase Management; Store Management; Safety Management; Statistical Process Control; Total Quality Management; QMS and ISO Standards

PRACTICES:

- Job shop scheduling problem
- Representation of scheduling instances
- Guidelines for material quality
- Importance of scheduling and production planning processes
- Key factors scheduling production of products
- Inefficiencies in production planning and scheduling
- Optimize production scheduling
- ERP online manufacturing scheduling software
- Key to effective quality control
- Best practices recommended for Quality Assurance
- Systematic approach to quality management planning

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the production and operations man-age-ment	Apply	1	1, 2, 12
2	Understand types of management systems	Apply	1	1, 2, 5, 12
3	Understand capacity design and determination of Material Required	Apply	1	1, 2, 3, 5, 12
4	Study overall production and operations man-age-ment	Analyze	2	1, 2, 12
5	Study Budgeting and material planning and man-agement	Analyze	2	1, 2

TEXT BOOKS:

1. Production and Operations Management by Adam and Ebert.
2. Operations Management by William Stevenson.

REFERENCE BOOKS:

1. Operations Management by William J Stevenson.
2. Production and Operations Management by Panneerselvam.
3. Operations Management by A P Verma.

22FT804 PROJECT PLANNING PREPARATION AND MANAGEMENT

Source: https://www.prince2.com/uk/blog/importance-planning-projects

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Strategic management, Risk management.

COURSE DESCRIPTION AND OBJECTIVES:

The main objectives of the course are to: Learning of different project management methods, tools and techniques. Planning, executing, monitoring and controlling of projects from beginning to the end.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION OF PROJECT PREPARATION AND DESIGN:

Definition of Project ; Project Life cycle; Projects in the context of strategic management; Organization - Structure and culture; Stakeholders and Roles; Challenges and opportunities; Goal hierarchy; Logical framework; Project strategy -Technology strategy; Organizational strategy; Scheduling.

UNIT-2 **10L+10T+0P=20 Hours**

PROJECT PROPOSAL AND RISK MANAGEMENT:

Budgeting/cost estimation; reducing project duration and risk assessment; Project proposal/authorization; Resource scheduling; Standards.

PRACTICES:

- The fundamentals of project selection criteria
- Build your business case for the project
- Develop a project brief
- Create a project plan
- Plan for setbacks and how to take corrective action
- Tracking related to the project
- Project documents up to date

MODULE–2

UNIT-1 **8L+8T+0P=16 Hours**

PROJECT SELECTION METHODS AND EVALUATION:

Introduction and Improvement R & D decisions and execution; Integrated selection and evaluation using multiple -Attribute decision-making technique; Contract management reviewing and outsourcing.

UNIT-2 **8L+8T+0P=16 Hours**

PROJECT EXECUTION AND MONITORING:

Managing Implementation; Project audit and closure; Project oversight - Monitoring and evaluation process and its importance; Presentation of data for analysis; Practices and leveraging knowledge capabilities; Progress & performance measurement and evaluation.

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SKILLS:

- ✓ *Determining project objectives and target groups.*
- ✓ *Define project goals, outputs, estimate barriers.*
- ✓ *Perform cost-benefit analysis of the proposed project.*
- ✓ *Identify and utilize suitable sources of information in defining problem solutions.*

PRACTICES:

- Benefit measurement methods
- Economic model
- Scoring model
- Payback period
- Net present value
- Discounted cash flow
- Internal rate of return
- Opportunity cost
- Constrained optimization methods
- Non-financial considerations

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To apply the fundamental knowledge of project planning and implementation.	Apply	1	1, 2, 12
2	Analyze types of strategy and their effect on plant management.	Apply	1	1, 2, 5, 12
3	Create a continuous system to evaluate project.	Apply	1	1, 2, 3, 5, 12
4	Investigate project planning and execution relation in food.	Analyze	2	1, 2, 12
5	Design new projects and analysis.	Analyze	2	1, 2

TEXT BOOKS:

1. H. R. Kerzner, “Project Management: A Systems Approach to Planning, Scheduling, and Controlling”, 11th edition, John Wiley & Sons, 2013.
2. D. I. Cleland, “Project Management: Strategic Design and Implementation”, 5th edition, Mc Graw-Hill: New York, 2007.

REFERENCE BOOKS:

1. E. Larson and C. Gray, “Project Management: The Managerial Process”, 6th edition, Mc-Graw Hill, New York. 2014.
2. P. Chandra, “Projects: Planning – Analysis”, 7th edition, Mc Graw Hill, New York. 2009.

22FT805 STRATEGY AND MARKETING OF FOOD PRODUCTS

Source : https://podfoodsco.medium.com/4-marketing-strategies-to-build-your-food-brand-2f469662fd16

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Principles of Management & Organizational Behavior.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the strategies for production and marketing of new product. To train students in the different aspects of marketing such as, planning process, channel organization, and channel strategy. Enhance customer relationships. Improve internal communications. Increase profit.

MODULE–1

UNIT-1 **6L+6T+0P=12 Hours**

INTRODUCTION OF AGRICULTURE AND FOOD MARKETING:

Marketing sub-systems; Marketing functions; Links between agriculture and the food industry; Agricultural and food marketing enterprises; Marketing boards in developing countries; Co-operatives in the agriculture and food sectors; Control and management of secondary co-operatives; Weakness of co-operatives.

UNIT-2 **10L+10T+0P=20 Hours**

MARKET LIBERALIZATION:

Economic structural adjustment programs; Macro-economic stabilization; Role of the state in liberalized markets; Dealing with accumulated deficits; Government action to improve private sector performance; Marketing; strategy; Planning and control- strategy; Policy and planning; Strategic business units; Marketing; Planning; Process & control.

PRACTICES:

- Developing a marketing strategy
- Positioning your product
- Food Marketing Issue
- Price and Competition in Food Markets
- Wholesaling and Retailing of Food Products
- International Food Markets
- Food Market Structure
- Food Market Development
- Production Costs, Demand, and Competition

MODULE–2

UNIT- 1 **8L+8T+0P=16 Hours**

NEW PRODUCT DEVELOPMENT PROCESS AND PRICING DECISION:

Definition and importance of new product development; New product development process; Adoption process; Effect of product characteristics on the rate of adoption; Pricing objectives; Laws of supply and demand; Elasticity of demand- Cross price elasticity of demand; Practical problems of price theory; Cost -Revenue- Supply relationships; Meaning of price to consumers; Price as an indicator of quality.

SKILLS:

- ✓ *Formulate marketing strategy for food products.*
- ✓ *Implement the planning strategy for food products.*
- ✓ *Evaluate the marketing planning for food products.*
- ✓ *Develop good customer relationships.*

UNIT-2 **8L+8T+0P=16 Hours**

COST- PLUS METHODS AND MARKET RESEARCH:

Cost-plus methods of price determination; Breakeven point analysis; Pricing - market-oriented pricing; psychological pricing; Brief on market research and process; Purpose of research; Research proposal; Marketing costs and margins - Assessing the performance of a marketing system; Pricing efficiency; Identifying marketing costs and margins; Handling costs; Packaging costs; Transport costs; Storage costs; Processing costs; Capital costs.

PRACTICES:

- Benefits of New Product Development Process for Businesses
- Innovation and Idea Generation
- Strengthen and Formalize the Concept Development Process
- Concept Testing
- Best Practices for Your New Product Development Process
- Advantages and Disadvantages of a Cost-Plus Pricing Strategy
- Common Pricing Methodologies

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply different marketing strategy for enhanced market trend.	Apply	1	1, 2, 12
2	Analyse and understand principle of supply chain management.	Apply	1	1, 2, 5, 12
3	Evaluate the segment and positioning of various food products.	Apply	1	1, 2, 3, 5, 12
4	Create new product pricing model for food products.	Analyze	2	1, 2, 12
5	Analyse market trend through market research.	Analyze	2	1, 2

TEXT BOOKS:

1. M. Crawford, “Agricultural and Food Marketing Management (Marketing & Agribusiness Texts)”, 1st edition, Food & Agriculture Organization of the United Nations (FAO), 1997.

REFERENCE BOOKS:

1. S. Andrews, “Textbook of Food and Beverage Management”, 1st edition, McGraw Hill, 2010.

22FT806 BIOPROCESS ENGINEERING

Source: https://ilb.uni-hohenheim.de/en/88779

Hours Per Week :

L	T	P	C
2	2	-	**3**

PREREQUISITE KNOWLEDGE: Food Process Engineering, Food microbiology, Heat and mass transfer.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an opportunity to understand the principles of biochemical engineering and microbial growth kinetics such as design aspects of bioreactor for the upstream and downstream processing, application of the biotechnological concepts in the production of biologicals, and also microbial technology application in food processing and bio-refineries.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

HISTORY AND DEVELOPMENT:

Historical development of bioprocess technologies; Role of bioprocess engineer in the food biotechnology industry; Concept of bioprocess; Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses; General requirements of fermentation processes; Isolation, preservation and strain improvement of industrially important micro-organisms-market analysis.

UNIT-2 **4L+8T+0P=12 Hours**

BIOREACTOR DESIGN AND ANALYSIS:

Batch and continuous fermenters; Upstream processing: Media formulation and optimization; Media-sterilization, heating and cooling; Aeration, Agitation and heat transfer in bioprocess; Thermal growth kinetics of microorganisms; Scale up and scale down; Measurement and control of bioprocess parameters; Equipment and plant costs.

PRACTICES:

- Evaluating the enzyme catalysis during the enzyme production of glucose, fructose, starch, SCP and mushrooms.
- Design of bioreactor for the production of beer.
- Evaluating the thermal growth kinetics of microorganism during the production of fermentation foods.
- Scaling up the process for the development of fermented products.

MODULE-2

UNIT-1 **12L+2T+0P=14 Hours**

DOWNSTREAM PROCESSING AND PROCESS ECONOMICS:

Separation of insoluble products- filtration, centrifugation, sedimentation, flocculation; Cell disruption; separation of soluble products: liquid-liquid extraction, precipitation, chromatographic techniques, reverse osmosis, ultra and micro filtration, electrophoresis; Final purification-drying, crystallization, storage and packaging; Batch-process cycle times and continuous cultures; Recovery costs; Water usage and recycling; Effluent treatment and disposal.

Microbial Technology in food processing: Types of fermentation; Aerobic and anaerobic fermentation processes; Solid-substrate fermentation; Probiotics and prebiotics; Fermented foods and beverages; food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods.

SKILLS:

- ✓ *Analyze the principles and mechanism of immunological detection of pathogens in foods.*
- ✓ *Infer about the application of biotechnology in food processing and agricultural practices.*
- ✓ *Designing aspects of bio-reactor including the upstream and downstream processing.*

UNIT-2 **4L+14T+0P=18 Hours**

PRODUCTION OF BIOLOGICAL SUBSTANCES:

Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins from lactic acid bacteria-production and applications in food preservation; Production of antibiotics in a reactor; Production of single cell protein; Producing colours and flavours, alcoholic beverages (i.e., beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka) and other products; Propagation of baker's yeasts; Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); Applications of Microbes in pickling; Applications of solid-substrate fermentation in production of various foods grade products (i.e., organic acids (lactic acid, citric acid) and xanthan gum).

PRACTICES:

- Production of citric acid by solid state fermentation
- Production and recovery of Penicillin
- Production and recovery of Vitamin B12
- Solid state fermentation

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Demonstrate the concept of microbial kinetics in bi-ochemical engineering.	Apply	1	1, 2, 4, 5, 6, 7, 12
2	Apply the concept of stoichiometry in the modelling of microbial growth.	Apply	1	1, 2, 3, 4, 5, 6, 8,12
3	Apply the principles of different upstream and downstream processes involved in bioprocesses.	Apply	2	1, 2, 5, 9, 10, 12
4	Apply the concept of microbial technologies in food processing and bio-refineries as well as production of biologicals.	Apply	1, 2	1, 2, 3, 5, 6, 7, 9, 10, 11, 12
5	Design and analyse different bioreactor systems and their components.	Create	2	1, 2, 3, 4, 6, 7, 8, 9

TEXT BOOKS:

1. Shuler, M. L., & Kargi, F. (2002). Bioprocess engineering: Basic concepts. Upper Saddle River, NJ: Prentice Hall.
2. J. E. Bailey & D. F. Ollis,"Biochemical Engineering Fundamentals, 1st edition, Mc Graw Hill Book Company, 1986

REFERENCE BOOKS:

1. Pauline Doran (1995) Bioprocess engineering principles. Elsevier Science & Technology Books.
2. Stanbury, P. F., & Whitaker, A. (1997). Principles of fermentation technology. Oxford: Pergamon Press.
3. Harrison, R.G., Todd, P., Rudge, S.R., and Petrides, D.P. (2015). Bioseparations Science and Engineering. 2nd Edition. Oxford University Press.

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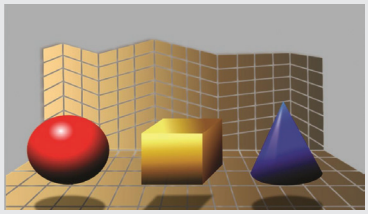
22FT807 ENGINEERING PROPERTIES OF FOOD MATERIALS



Source: https://agrimoon.com/wp-content/uploads/Engineering-Properties-of-Biological-Materials-and-Food-Quality.pdf

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Physics, Food process operations, Thermodynamics, and Heat transfer.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the evaluation and application of engineering properties of food materials under different conditions. The objective of this course is to enable the students to understand physical, chemical, gravimetric and mechanical properties of food and their application in designing of engineering processes and equipment.

MODULE - 1

UNIT – 1 **14L+4T+0P=18 Hours**

PHYSICAL AND MECHANICAL PROPERTIES:

Engineering properties of food and biomaterials - structure and chemical composition of foods;

Physical properties: Shape-determination methods; Surface area-determination methods; Volume-determination methods; Density-determination methods; Sphericity-determination methods; Porosity-determination methods; Specific gravity-determination methods; Moisture in food and biological materials; Water activity-food stability; Sorption and desorption isotherm of food materials; and Color-determination methods.

Mechanical properties: Strain and stress; Viscosity; Elasticity; Visco-elasticity; Newtonian and Non-Newtonian fluid; Time dependent fluids; Creep and relaxation phenomena; Texture profile analysis

UNIT – 2 **2L+12T+0P=14 Hours**

MEASUREMENT METHODS OF PHYSICAL AND MECHANICAL PROPERTIES:

Moisture in food and biological materials; Water activity-food stability; Sorption and desorption isotherm of food materials; and Color-determination Evaluate the sorption and desorption of food materials.

PRACTICES:

- Determining the shape and surface area of food materials.
- Determining the density, specific gravity and volume of food materials.
- Determining the color and water activity of food materials.
- Determining the rheological properties of food materials.
- Determining the textural properties of baked food materials.

MODULE – 2

UNIT – 1 **14L+2T+0P=16 Hours**

THERMAL, ELECTRICAL, OPTICAL, AND AERO-DYNAMIC PROPERTIES:

Thermal properties: Specific heat capacity; Thermal conductivity; Thermal diffusivity; Convective heat transfer coefficient; Cooling and phase change.

Electrical and magnetic properties: Electrical conductivity; Impedance; Electrical resistance; Electrical capacitance; Die-electrical properties; Magnetic field; Magnetic flux density; Magnetic Susceptibility; Magnetization;

Optical properties: Light transmittance; Light reflectance; Light absorbance; Light Intensity

Aero and/or Hydro-dynamic properties: Drag co-efficient; terminal velocity; Frictional Properties-Co-efficient of friction, angle of repose, rolling resistance, and co-efficient and angle of internal friction.

SKILLS:

- ✓ *Measure the physical, thermal, aerodynamic properties of food materials.*
- ✓ *Suggest equipment design based on the properties of food material.*
- ✓ *Analyze and interpret textural profile of various foods*

UNIT – 2 **2L+14T+0P=16 Hours**

MEASUREMENT METHODS OF OTHER ENGINEERING PROPERTIES:

Determining the thermal properties of food materials; Determining the electrical conductivity, die-electrical, and magnetic flux density of food materials; Determining the electrical conductivity, die-electrical, and magnetic flux density of food materials; Determining the optical properties of food materials; Determining the electrical conductivity, die-electrical, and magnetic flux density of food materials.

PRACTICES:

- Determining the aero and/or hydro-dynamic properties of food materials
- Determining the frictional properties of food materials.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Discuss the significance of water activity in extending the shelf life of foods.	Apply	1	1, 2, 3, 4, 5, 6, 8,12
2	Estimate the engineering properties of various food and biomaterials.	Analyze	1,2	1, 2, 4, 5, 6, 7, 10, 12
3	Identify, formulate and solve biological engineering problems based on the physical and engineering properties of food material.	Analyze	1, 2	1, 2, 3, 4, 6, 7, 8, 9,11

TEXT BOOKS:

1. S. Sahin and S. G. Sumnu, “Physical Properties of Foods”, 1st edition, CRC press, USA, 2006.
2. N. N. Mohesenin, “Physical Properties of Plant and Animal Materials”, 2nd edition, Gordon & Breach Science Publishers, 1986.

REFERENCE BOOKS:

1. M. A. Rao, and S. S. H. Rizvi, “Engineering Properties of Foods”. 4th edition. CRC Press, USA, 2014.
2. M. J. Lewis, “Physical Properties of Foods and Food Processing Systems Cambridge” 1st edition, Woodhead Publishing Limited, UK, 1990.

22FT808 INSTRUMENTATION AND PROCESS CONTROL

Source: https://shop04004.shadrychant.com/content?c=instrumentation%20and%20process%20control&id=18

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Engineering Physics, and Engineering mathematics.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the principles, handling and control of various equipment's used in food industry. The objective of this course is to enable students to gain knowledge about different process instruments, various control systems and application of these control system in various processes.

MODULE–1

UNIT-1 **8L+4T+0P=12 Hours**

INTRODUCTION TO PROCESS CONTROL AND INSTRUMENTATIONS:

Introduction: Definitions; Instrument; Controller and recorder; Principle of measurement; Static and dynamic characteristics of instrument; Transducers - types & classification and selection criteria, basic principles;

Moisture content measurement: Role of moisture content in food; Weight and dry method; Moisture release measurement; Humidity measurement - definitions, role in food processing, classification and types, wet and dry bulb hygrometer; Temperature Measurement-mercury thermometers.

UNIT-2 **8L+14T+0P=22 Hours**

CALIBRATION OF INSTRUMENTS:

Error analysis and its calibration; Construction and applications of transducer elements; Strain gauge with bridge circuits and calibration procedures.

PRACTICES:

- Determination of moisture in food samples by microwave absorption method, RF technique, IR technique, and DC resistance technique.
- Electronic methods to determine humidity in food storing rooms/storage structures/cold storages.
- Temperature measurement during food process operations by bimetal thermometers, capillary type thermometers, recording thermometers, thermocouples, resistance thermometers, thermistor.

MODULE–2

UNIT- 1 **10L+6T+0P=16 Hours**

CONCEPTS OF VARIOUS INSTRUMENTATION:

Turbidity and colour: Definition and role; Standards and Units; Basic turbidity meter - light scattering type, absorption type, reflectance type; Pressure measurement-pressure gauge, elastic deformation elements, basic concept of pneumatic pressure transmitter.

Fluid flow and viscosity: Flow measurement - magnetic flow meter, digital flow meter, turbine flow meter, gravimetric feeder; Definition of viscosity; Newtonian and Non-Newtonian flow; various types of Viscometers-Principles.

SKILLS:

- ✓ *Identify the process variables.*
- ✓ *Handle refractometer, electronic noise, bio sensor, enzyme sensors.*
- ✓ *Calculate moisture content of food using different methods.*
- ✓ *Measure turbidity, color, viscosity of food material*

UNIT- 2 **6L+10T+0P=16 Hours**

APPLICATIONS OF INSTRUMENTATIONS:

Biosensors: Types of biosensors - principle and application; Controllers and indicators basic control concept; Ratio control in food pickling; Timers and indicators.

Moisture measurement of granular materials; Humidity Measurement; Microwave and infrared sensors for protein and fat content; Applications of biosensors in food industry.

PRACTICES:

- Color measurement of food samples by colorimeter and digital image processing method.
- Application of pressure current and pressure resistance transducers in the measurement of pressure.
- Measurement of liquid/ semi-solid food flow by various flow meters.
- Measurement of food viscosity by various types of viscometers.
- Temperature controllers in various dryer's operation.
- Head space gas control in food preservation methods.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply process variables in food processing.	Apply	1	1, 2, 4, 5, 6, 7, 12
2	Investigate application of different control processes for parameter monitoring..	Apply	1	1, 2, 3, 4, 5, 6, 8,12
3	Analyze the principle behind operation of process control equipment's	Analyze	1, 2	1, 2, 3, 4, 6, 7, 8, 9
4	Design of specific control measures for food processing.	Create	1	1, 2, 5, 9, 10, 11, 12

TEXTBOOKS:

1. M. Bhuyan, "Measurement and Control in Food Processing", 1st edition, CRC Press, 2007.
2. R. G Moreira and T. P Coultate, "Automatic Control for Food Processing System", 1st edition, 2001.

REFERENCEBOOKS:

1. D. Patranabis, "Industrial Instrumentation", 1st edition, McGraw Hill, 1990.
2. B. G. Liptak, "Instrument Engineers Handbook: Process Measurement and Analysis", 1st edition, Butterworth and Heinemann, 1995.

22FT809 MAINTENANCE OF FOOD EQUIPMENT

Source: https://www.dreamstime.com/food-worker-maintenance-machine-industry-operate-packing-image152404506

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Food processing operations.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with maintenance of food processing equipment. The objective of this course is to enable the students to plan and implement various maintenance methods to increase the efficiency of equipment by minimizing the waste production and maximizing the profit.

MODULE-1

UNIT-1 **14L+2T+0P=16 Hours**

MAINTENANCE MANAGEMENT SYSTEMS:

Introduction: Maintenance systems - maintenance objectives and scopes, maintenance strategies and organizations, maintenance works, life cycle costs; Preventive Maintenance - principles of preventive maintenance, procedures and selection, preventive maintenance planning, scheduling and control, forms and resources, maintenance work measurement.

Maintenance management system: Modelling and analysis techniques in PM and inspections; Predictive maintenance; Computerized maintenance management systems - benefits and applications, work order systems and plant registers; Introduction to commercial packages.

UNIT-2 **4L+12T+0P=16 Hours**

EQUIPMENT MAINTENANCE:

Installation and checks-commissioning and testing of plant equipment, checking for alignment, lubrication and lubrication schedule; Documentation on the installation and checks of various food equipment's in food industries.

PRACTICES:

- Case studies interfacing areas with maintenance reports, analysis, and monitoring of computerized maintenance management systems in food industries
- Case studies interfacing areas with maintenance strategies of typical rotating and process equipment systems like turbines, pumps and fans, centrifuges, heat exchangers, boilers, and pressure vessels.
- Case studies interfacing areas with maintenance planning and scheduling of process equipment into PM and predictive maintenance.

MODULE - 2

UNIT-1 **12L+2T+0P=14 Hours**

EQUIPMENT MAINTENANCE STRATEGIES:

Reliability concepts: Basic concepts of probability theory and distributions; Definition - reliability, failure probability, reliability, and hazard rate function; MTBF and MTTR; System reliability; Redundancy.

Maintenance management strategies: Seven basic questions for RCM; RCM procedures; Benefits of RCM; Goals of TPM and methodology; TPM improvement plan and procedures.

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SKILLS:

- ✓ *Suggest a plan and implement the techniques in maintenance of equipment.*
- ✓ *Demonstrate the installation of food equipment.*
- ✓ *Execute energy minimization policy plans.*
- ✓ *Identify and implement cost reduction strategies.*

UNIT-2 **4L+14T+0P=18 Hours**

APPLICATIONS OF EQUIPMENT MAINTENANCE STRATEGIES:

Series and parallel system in various food equipment reliability process

PRACTICES:

- Evaluation of reliability, failure probability, and hazard rate function on various food processing equipment.
- Evaluation of series and parallel system in various food equipment reliability process.
- Implementation of MTBF and MTTR on various food processing equipment's.
- Implementation of RCM and improved TPM plans in different food industries.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the principals and strategies for equipment maintenance.	Apply	1	1, 2, 4, 5, 6, 7, 12
2	Plan the schedule and preventive maintenance requirement.	Analyze	1	1, 2, 3, 4, 5, 6, 8,12
3	Formulate and investigate maintenance schedule for better maintenance.	Analyze	2	1, 2, 5, 9, 10, 12
4	Develop the knowledge of food safety concepts to food manufacturing processes.	Create	1, 2	1, 2, 3, 4, 6, 7, 8, 9,11

TEXT BOOKS:

1. R. E. Greaves, "The Commercial Food Equipment Repair and Maintenance Manual", 1st edition. Cbi Pub Co. 1987.
2. M. M. Cramer "Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices", CRC Press, 2006.

REFERENCE BOOKS:

1. S. Riccetti, "Designing Food Safety and Equipment Reliability through Maintenance Engineering, Productivity", 2nd edition, CRC Press. 2013.
2. R. K. Mobley, "Maintenance Engineering Handbook", 8th edition, McGraw-Hill Professional, 2014.
3. L. H. Lelieveld, H. John, and N. David, "Hygiene in Food Processing: Principles and Practice", 1st edition, Elsevier, 2014.

22FT810 REFRIGERATION ENGINEERING AND COLD-CHAIN

Source: https://kipfinancial.com/wp-content/uploads/2021/02/Integrated-Cold-Chain-Project.jpg

Hours Per Week :

L	T	P	C
2	2	-	3

PRE-REQUISITE KNOWLEDGE: Food processing and preservation, Thermodynamics, and Heat transfer.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with refrigeration process, equipment and cold chain management for food. The objective of this course to make students understand the refrigeration process, concepts of freezing and its application in processing; cold chain design and storage for increasing shelf life of food.

MODULE - 1

UNIT-1 **12L+4T+0P=16 Hours**

REFRIGERANT SYSTEMS:

Refrigerants- classification, properties and characteristics of refrigerants; Phase-out of ozone depletion refrigerants, Refrigeration processes and refrigeration cycles, Types of refrigeration systems-vapour compression and vapour absorption refrigeration systems; Use of blowers in refrigeration systems; Cold storage, Principles of aeration and ventilation in cold storage.

Freezing: Slow and rapid freezing; Equipment's used for freezing water in foods; Freeze concentration of liquid food; Planck's equation; Impact of freeing on quality of foods.

UNIT-2 **4L+12T+0P=16 Hours**

DESIGN AND PERFORMANCE OF REFRIGERATION SYSTEMS:

Refrigeration – Types, Design, Performance. Calculation of refrigeration loads and heat loads. Applications of refrigeration in food storage and processing.

PRACTICES:

- Determination of refrigeration loads and heat loads, design of refrigeration systems i.e., cold storages for food commodities
- Estimating the time to freeze the different food samples in various types of freezers,
- Production of crystalline foods - sucrose and lactose;
- Application of refrigeration systems in various food processing products (i.e., fruits and vegetables, meat products, fish, poultry products, dairy products) and their process operations.

MODULE - 2

UNIT-1 **8L+0T+0P=8 Hours**

BASIC CONCEPTS OF COLD-SUPPLY CHAIN MANAGEMENT:

Cold chain-definition need for the chain for chilled/frozen food items; Various links of the chain; Importance of shelf-life; Just-in-time deliveries/Temperature limits; Pallet layout and stacking options; Flexible storage systems.

UNIT-2 **8L+16T+0P=24 Hours**

APPLICATION OF COLD SUPPLY CHAIN IN FOOD SUPPLY CHAIN:

Cold chain management from farm to fork land and export; Retail, supermarket cold chain and display systems – temperature-time indicators (TTI); Effective temperature transportation regulations by regulation bodies (FSSAI, US-FDA).

SKILLS:

- ✓ *Suggest a system, component or process to meet desired refrigeration needs.*
- ✓ *Estimate freezing time for different food products.*
- ✓ *Design the layout of warehouse unit*

PRACTICES:

- Kinetic approaches for evaluating the shelf-life under cold supply chain
- Impact of various packaging materials on quality attributes of food commodities during their cold supply chain - MAS, MAP, CAS, CAP etc.
- Identification of commonly occurred food borne diseases, and the precautionary food safety measures has to be taken during cold supply chain of food commodities.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of cold supply chain management in various food processing operations.	Apply	1	1, 2, 5, 9, 10, 12
2	Analyze refrigeration and air conditioning systems.	Analyze	1	1, 2, 4, 5, 6, 7, 12
3	Evaluate refrigeration systems performance.	Evaluate	1, 2	1, 2, 3, 4, 6, 7, 8, 9
4	Design refrigeration process and equipment.	Create	1	1, 2, 3, 4, 5, 6, 8,12
5	Formulate cold supply chain management plan	Create	1, 2	1, 2, 3, 5, 6, 7, 9, 10, 11, 12

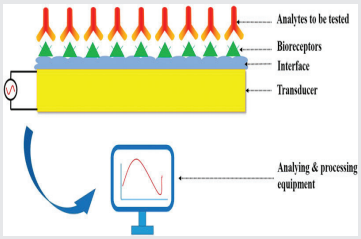
TEXT BOOKS:

1. C. P. Arora, “Refrigeration and Air Conditioning”, 3rd edition, Tata Mcgraw Hill Education, 2006.
2. M. L. Anand, “Refrigeration& Air-Conditioning”, 1st edition, Asian Books Pvt., Ltd., 2002.

REFERENCES:

1. Da-Wen Sun, “Advances in Food Refrigeration”, 1st edition, Leatherhead, 2001.
2. K. J. Christopher, “Managing Frozen Foods”, 1st edition, CRC Press, 2000.

22FT811 BIOSENSOR DESIGN AND APPLICATION



Source: https://www.frontiersin.org/articles/10.3389/fmats.2020.583739/full

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Fundamentals of biosensors, its application in various fields.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the field of examining the biochemical reaction that occurs in foods through the usage of biosensors, designing aspects of biosensors, its classification, common assaying formats that has been followed in various food processing industries.

MODULE–1

UNIT-1 **12L+4T+0P=16 Hours**

BASIC CONCEPTS OF BIOSENSORS:

Introduction to biosensors: Definition of biosensors, classification and food applications: medicine, agriculture, bioproduction, and environment; Desired characteristics of biosensors: reliability, simplicity, cost, and related parameters; Applications: operating conditions, calibration, positive and negative controls, safety.

Biochemical recognition: Chemical reactions: history of gravimetric and colorimetric reactions. Problems of specificity; Enzymes: biological catalysts, specificity, activity, storage/shelf life. Enzyme kinetics in solution and on a surface. Chemical equilibria- forcing an unfavourable reaction; Cells: Signal transduction through chemoreception, membrane potential, cell metabolism, cytotoxicity, and transformed 'bioreporter' organisms.

UNIT-2 **4L+12T+0P=16 Hours**

APPLICATION OF BIOSENSORS:

Biosensors application in food processing, preservation, storage and transport

PRACTICES:

- Demonstration of general operating conditions and design of biosensors.
- Demonstration of enzyme immobilization of biological components using biosensors
- Demonstration of the application of biosensors in food processing industries

MODULE–2

UNIT-1 **12L+4T+0P=16 Hours**

COMMON ASSAYING FORMATS:

Labels: Radioisotopes, fluorophores, dyes, enzymes/substrates, liposomes, electroactive compounds. ELISAs and nucleotide capture assays. Immobilization of bio recognition element; conjugation of labels.

Electrical signal transduction: Seismic (mass) and thermal sensors: Electromechanical resonance, electrochemical forces, Henry's and ideal gas laws; Surface acoustic wave (SAW) devices; atomic force microscopy; manometric sensors; thermometric detection. Electrochemical sensors: Redox potentials, membrane potential, Gauss's Law, basic electrochemistry; conductimetric sensors; potentiometric sensors (ISEs and ISFETs); amperometric sensors; Charge sensing with FET. Optical sensors: fundamentals of optics- sources (LED's, lasers, lamps), detectors (photodiodes, photomultiplier tubes, charge-coupled devices), and optical circuits (filters, gratings, fiber optics); detection of absorbance, reflectance, and fluorescence; Surface plasmon resonance (SPR) based devices.

SKILLS:

- ✓ *Should be able to understand the concept of biosensors*
- ✓ *Design and development of biosensors*
- ✓ *Utilization of bi-osensor devices in various food applications*

UNIT-2 **16L+0T+10P=26 Hours**

ADVANCED APPLICATIONS OF BIOSENSORS:

Various other application of biosensors in food processing industries: surface acoustic wave devices, electrochemical and surface Plasmon resonance-based devices.

PRACTICES:

- Case study on application of surface acoustic wave devices in food industry.
- Case study on type's electrochemical sensors and its food applications.
- Demonstration on surface Plasmon resonance-based devices.

COURSE OUTCOMES:

The students will be able to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concept of biosensors and its classification	Apply	1	1,2,7
2	Application of biosensors in biochemical recognition	Apply	1	1,2,3,4
3	Application of biosensors in various food assessments	Apply	2	1,2,34,5,8
4	Analysis of biosensors in various other fields	Analyze	2	1,2,3,4,6,7

TEXT BOOKS:

1. Kress-Rogers, Erika. Handbook of biosensors and electronic noses: medicine, food, and the environment. CRC Press, 1996.
2. Monosik, Rastislav, Miroslav Stredanský, and Ernest Sturdik. "Biosensors-classification, characterization and new trends." Acta chimica slovaca.

REFERENCE BOOKS:

1. Turner, Anthony, Isao Karube, and George S. Wilson. Biosensors: fundamentals and applications. Oxford university press, 1987.
2. Ajit Sadana & Neeti adana, "Handbook of biosensors and biosensor kinetics",5th edition, Elsevier Science, 2011.

   Jagrati Narag & C.S. Pundir, Biosensors: An Introductory Textbook, 2nd edition, Jenny Stanford Publishing 2017.

22FT812 FOOD QUALITY ASSURANCE AND CERTIFICATION

Source: https://stevethedoc.wordpress.com/2020/02/05/what-is-quality/

Hours Per Week :

L	T	P	C
2	2	-	**3**

PREREQUISITE KNOWLEDGE: Understand the concept of food quality and safety management systems.

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with global food safety, security, Food laws, standards and regulations. The objective of this course is to impart knowledge to students on national and international food standards along with the application of ISO and HACCP in food processing industries.

MODULE –1

UNIT-1 **12L+4T+0P=16 Hours**

FOOD SAFETY, QUALITY AND ASSURANCE:

Introduction: Introduction to food safety; Food security; Concept of food safety and standards (FSSAI); Licensing and registration (FSSAI); Food hazards and contaminations – physical hazards, chemical hazards (toxic constituents/ hazardous materials, pesticide residues/ environmental pollution/ chemicals), biological hazards (Bacteria, viruses and parasites), trace chemicals. Quality control vs quality assurance; Introduction to total quality management; Food-related hazards; Microbiological considerations in food safety; HACCP - terminology, principles, identification of CCPs, application of HACCP system in industries, and the logic sequence involved.

International food laws: Codex Alimentarius commission – the role of CAC and its committees; Introduction to OIE and IPPC; Introduction of other international food standards; WTO - introduction to WTO agreements, SPS and TBT Agreement, implications on trade in light of SPS and TBT; FAO - overview of organization structure, objectives, and functions.

UNIT-2 **4L+12T+0P=16 Hours**

FOOD QUALITY ANALYSIS:

Proximate analysis of food components, Chromatographic techniques (Paper, GC, HPLC, TLC).

PRACTICES:

- Determination of proximate compositions of foods to certify the quality
- Detection of adulterants in different food products: Test for metanil yellow, Test for starch, Baudouin test, the boric acid test for turmeric.
- Determination of organochlorine pesticides in water by GC method;
- Acesulfame K detection in sweets by TLC,
- Sensory evaluation- taste identification test.

MODULE –2

UNIT-1 **12L+2T+P0=14 Hours**

FOOD STANDARDS AND CERTIFICATION:

Indian standards: AGMARK act and rules - title, definitions, certification procedure, laboratory approvals and action on non-compliance, appeals; BIS – the evolution of BIS, scope, definitions, power & functions of BIS, licensing procedure, export and import laws and regulations, export (Quality control and Inspection) act, 1963; APEDA - Introduction, act and rules, function, product monitored.

ISO: ISO 9001:2008 – the evolution of ISO 9001:2008, PDCA cycle, introduction to contents of the standards, salient features, advantages of implementation of the standard, certification & auditing;

SKILLS:

- ✓ *Analyze the role and importance of food safety*
- ✓ *Understand the role of different organizations involved in food certification*
- ✓ *Apply the concept of food labeling in new product development*
- ✓ *To know the importance of various Indian standards in food certification.*

Introduction to the family of ISO 22000 standards-FSMS 22000:2005, various elements and clauses included in the standard; Comparison of ISO 9001:2008 vs. ISO 22000:2005.

UNIT-2 **4L+14T+P0=18 Hours**

APPLICATION OF FOOD STANDARDS AND CERTIFICATION:

Apply different food standards to food commodities and food products.

PRACTICES:

- Demonstration on AGMARK act and rules; BIS standards.
- Case study on APEDA and its functions
- Demonstration on evolution ISO 9001:2008.
- Demonstration on implementation of the standards, certification and auditing.
- Demonstration on ISO 22000 standards-FSMS 22000:2005.
- Demonstration on setting and implementation of food standards in quality assurance.

COURSE OUTCOMES:

Upon completion of the course, the student will able to achieve the following outcomes :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic technique to ensure food safety	Apply	1	1,2,3,6,7,8
2	Applying the food standards and certificates in the different food industry	Apply	2	1,2,3,4,6,7,8, 10
3	Analyze the importance of international food laws in the food sector	Analyze	1	1,2,3,4,5,6,8
4	Analyze the importance of Indian food laws in the food sector	Analyze	2	1,2,3,4,5,6,8

TEXT BOOKS:

1. Amerine, M.A., Pangborn, R.M. and Rossles, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, London.
2. Early, R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.

REFERENCE BOOKS:

1. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
Lawless, H.T. and Klein, B.P. 1991. Sensory Science Theory and Applicatons in Foods. MarcelDekker

22FT813 FOOD TOXICOLOGY AND AGROCHEMICAL RESIDUES IN FOOD

Source: https://www.dailymail.co.uk/health/article-8007765/The-chemicals-fruit-veg-arent-scary-think.html

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Basic concepts of food toxicants, agrochemical residues and their identification.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the field of examining the interaction of toxins with food constituents and its risk assessment, risk communication, and risk management. The objective of this course is to enable the student to learn about the source, classification, effects of processing alteration, toxicity levels and eradication methods of different food toxins and agrochemical residues.

MODULE–1

UNIT-1 **12L+2T+0P=14 Hours**

TOXINS PRESENT IN FOODS:

Introduction to various toxins: Definition, classification of food toxicants, factors affecting the production of toxins, toxins derived from plants; Animals, Marine, Algae and Mushroom, Microbial toxins; Food poisoning; Foodborne infections and disease, Derived food toxicants- processing & packaging.

UNIT-2 **4L+14T+0P=18 Hours**

TOXINS DURING PROCESSING:

Toxicants generated during food processing such as nitrosamines, acrylamide, benzene, dioxins and furans, persistent organic pollutants; Toxicological aspects of nutrient supplements; Chemicals from processing such as fumigants; Chlorinated solvents; Autoxidation products; Carcinogens in smoked foods and pyrolysis.

PRACTICES:

- Demonstration on different toxins present in foods.
- Demonstration of microbial toxins and their identification.
- Demonstration on different marine toxins and methods to eliminate it.
- Demonstration of different toxins generated during food processing.

MODULE–2

UNIT-1 **12L+2T+0P=14 Hours**

AGROCHEMICALS AS TOXICANTS:

Sources of agrochemical Agrochemicals: Introduction; Agrochemicals in agriculture including growth regulators- Purpose, classification, methods of dispensing agrochemical, characteristics, methods of estimations of agrochemical; Agrochemical residues- pesticides, fungicides, herbicides, permitted levels of pesticides, fungicides, herbicides, toxicity details, methods of removal of agrochemical residues.

SKILLS:

- ✓ *Identify various sources of food toxin.*
- ✓ *Analyze and predict the toxic levels of contaminants in food.*
- ✓ *Suggest the permitted levels of agrochemical usage in food processing.*
- ✓ *Estimate the permissible limits of toxins and agrochemical residues.*

UNIT-2 **4L+14T+0P=18 Hours**

RIPENING AND LEACHING TOXINS:

Ripening toxins:

Types, Uses, Effects, Residue evaluation, Veterinary drugs including antibiotics and hormones: Purpose of use, Classification, Associated hazards and Toxicity.

Leaching of toxins: Uptake of agrochemicals from Soil, Water, Environment, Packaging by plant foods. Concept of organic farming and systems

PRACTICES:

- Demonstration of Codex Guidelines on Good Practice in Pesticide Residue Analysis.
- Demonstration on pesticide standards.
- Demonstration of agrochemical poisoning and its impact on human health.
- Demonstration of insecticides like organophosphorus.
- Demonstration on growth regulators and ripening toxins.
- Case study on leaching of the potentially toxic pollutants from composites based on waste raw materials.

COURSE OUTCOMES:

The students will be able to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of morphology, classification and identification of specific toxins	Apply	1	1,2
2	Investigate the agrochemical residues, ripening toxins	Apply	2	1,2,34,5
3	Detection of various toxins present in food	Analyze	1	1,2,3,4
4	Methods to determine the argro toxins and leaching of toxins	Analyze	2	1,2,3,4,7

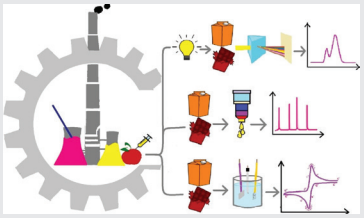
TEXT BOOKS:

1. E. Gallerdo & Mario Barosso, “Pesticide Toxicology”,4th edition, Humana Press, 2022
2. Ashish Sachan & Suzanne Hendrich, “Food toxicology, Current Advances and Future Challenges, 1st edition, 2017..

REFERENCE BOOKS:

1. J. N. Hathcock, “Nutritional Toxicology”, 1st volume, Academic Press, 1982.
2. M. Rechcigl, “Handbook of Naturally Occurring Food Toxicants”, 2nd edition, CRC Press, 1983.
3. S. Shabbir, “Food Borne Diseases”, 1st edition, Humana Press, 2007.

22FT814 INSTRUMENTAL METHODS OF FOOD ANALYSIS



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Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Engineering Chemistry, Food Chemistry, and Food Biochemistry..

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the principles, handling and control of various equipment used in the food industry. The objective of this course is to enable students to gain knowledge about different process instruments, various control systems and the application of this ecosystem in various processes.

MODULE –1

UNIT-1 **12L+0T+4P=16 Hours**

BASIC CONCEPTS OF INSTRUMENTAL ANALYSIS OF FOODS:

Introduction to different food sampling techniques: Raw materials, Definition of Population, Sample, Laboratory Sample, Official Samples, Precision, Accuracy, Sensitivity and Specificity, Reproducibility of analysis, Sampling and its techniques: Probability and Nonprobability sampling, Basic Principles of spectrophotometer and colorimeter and its application.

Carbohydrate Analysis – Introduction; Importance of carbohydrate analysis; Methods of analysis: Sample preparation and extraction of monosaccharide and Oligosaccharides. Chemical methods for carbohydrates - Gravimetric methods, titrimetric methods, Colorimetric methods: Anthrone method and phenol sulphuric acid method. Physical methods; Polarimetric method, Refractive index measurements, Density, Infrared radiation. Enzymatic methods. Immuno assays. Analysis of starch and crude fiber.

Protein analysis - Introduction, Importance of protein analysis; Protein Analysis: Protein concentration by Kjeldhal method, Dumas method and Enhanced Dumas method, Direct measurement at 280 nm, Biuret method, Lowry method, Dye binding method, and Turbidimetric method.

UNIT-2 **4L+0T+12P=16 Hours**

INSTRUMENTAL METHODS OF FOOD ANALYSIS:

Determination of carbohydrates by anthrone method, titrimetric and colorimetric method; Determination of CHO by phenol sulphuric acid methods; Determination of crude fibre by fibro plus apparatus; Determination of protein (Biuret, Lowry, Dumas and Kjeldhal method).

PRACTICES:

- Determination of carbohydrates by anthrone and spectrophotometry method.
- Determination of CHO by phenol sulphuric acid method.
- Determination of crude fibre using fibre plus apparatus.
- Protein determination by Biuret, Lowry, Dumes and Kjeldhal method.

MODULE –2

UNIT-1 **12L+0T+4P=16 Hours**

ANALYSIS OF FATS AND MINERALS:

Various methods involved in the detection of fats and minerals: Introduction, Importance of analysis of lipids. Determination of total lipid concentration: Solvent extraction, Non-solvent extraction, Instrumental methods. Determination of lipid composition:

Chromatography - Basic principles of Chromatography, Types of Chromatography and its application, Separation and analysis by chromatography, Lipid fractions of TLC, Fatty acid methyl esters by GC,

SKILLS:

- ✓ *Proficiency on analytical methods of food analysis.*
- ✓ *Suggest relevant test methods for food component.*
- ✓ *Perform qualitative and quantitative estimation of compound present in food.*
- ✓ *Propose equipment limitations, costs, advantages, disadvantages for analysis of food.*
- ✓ *Interpret the result from sophisticated instrument (HPLC, GC-MS) techniques.*

Fat characterization: Saponification value, Iodine value, free fatty acid value, Peroxide value; Analysis of minerals: Introduction; Importance of mineral analysis: Dry ashing, Wet ashing, Low Plasma Ashing, and adsorption spectroscopy.

UNIT-2 **4L+0T+12P=16 Hours**

Quantification and determination of fats, bioactive components present in foods. Determination of bioactive compounds through advanced instrumental methods like HPLC, GC-LC MS and its principles.

PRACTICES:

- Determination of fats in selected foods using socs-plus apparatus.
- Extraction of bioactive components using suitable solvents.
- Identification and separation of fats using paper chromatography technique.
- Separation of volatile oils through thin layer chromatography (TLC).
- Identification of saponification, iodine value, free fatty acids and peroxide value in selected fats and oils.
- Determination of total minerals present in foods using muffle furnace.

COURSE OUTCOMES:

The student will be able to understand the principle involved in methods of food analysis :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the different sampling techniques	Apply	1	1,2,7
2	Apply the instrumental techniques in determination of fats and minerals	Apply	2	1,2,3,4,6,7,
10	Analyse the Distribution Generation Technologies	Analyze	2	1.2.4
3	Analyze the importance of sampling techniques	Analyze	1	1,2,3,4,5
4	Analyze the various instrumental techniques involved in the detection of CHO and protein	Analyze	2	1,2,34,5,8

TEXT BOOKS:

1. K. Wilson, and J. Walker, “Practical biochemistry Principles and Techniques”, 5th edition Cambridge press, 1994.
2. M. Kalia, “Food Analysis and Quality Control,” 1st edition. Kalyani Publishers, 2002.
3. S. S. Nielsen, “Food Analysis,” 3rd edition, Aspen Publishers, 1998.

REFERENCE BOOKS:

1. AOAC International, “Official methods of analysis,” AOAC International, 18th edition, 2007.
2. Y. Pomeranz and C.E. Meloan, “Food Analysis: Theory and practice,” 3rd edition, A.V.I Publish ing company, USA, 2013.
3. J. Jayaraman, “Laboratory Manual in Biochemistry,” 3rd edition, Wiley Eastern Publishers, New Delhi, 1980.

22FT815 SENSORY ANALYSIS OF FOOD

Source: https://consumer-insight.pl/en/training/corporate-training/sensory-training-workshop-tests/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Food Quality, Human Senses.

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with the different organoleptic quality parameters of food products and techniques to analyse. The objective of this course is to impart the knowledge to students on principles and techniques of sensory analysis of food and to apply their knowledge and skills acquired to solve the real world problem associated to food quality.

MODULE –1

UNIT-1 **12L+0T+2P=14 Hours**

BASICS OF SENSORY ANALYSIS:

INTRODUCTION: Basic definition of flavour; role and importance of flavour in foods; classification of flavour; flavoring compounds.

SENSORY CHARACTERISTCS OF FOODS: sample preparation and its importance to distinguish different flavour; study of Sweetness, sourness, saltiness, bitterness, Pungency, astringency, umami flavour in various food stuffs; role of sensory organs in flavour perception: smell, taste, visual observation, taste modifiers, threshold values. Sample preparation and its importance to distinguish different flavor;

UNIT-2 **4L+0T+14P=18 Hours**

SENSORY ASSESSENT OF FOODS:

Sensory properties of foods; factors influencing sensory; role and study of sensory organs in flavor; assessment; Importance of sensory evaluation; sensory assessments of flavor

PRACTICES:

- Identification of different flavors present in different classes of foods;
- Sample preparation to distinguish the different flavors present in foods;
- Study on role of sensory organs in determining the flavor perception among the selected set of people based on age and preferences;
- Experiment on taste modification and threshold values;
- Preparation of score card and sensory evaluation of prepared samples using 5 and 9-point hedonic scale

MODULE –2

UNIT-1 **12L+0T+4P=16 Hours**

SENSORY EVALUATION TESTS:

Measurements of sensory characteristics: 5- and 9-point hedonic scales. Paired comparison test; Duo-Trio, triangle test; ranking and hedonic tests; Importance of product development; independent product development; selection of sensory panelists: criteria for selection, age, qualification to conduct sensory test, other methods of sensory

UNIT-2 **4L+12T+0P=16 Hours**

FLAVOUR DETECTION TESTS:

Physical methods and instrumental methods like sensor based electronic nose; gas chromatography; ion mobility spectrometry based electronic nose; electronic eyes for colour detection.

SKILLS:

- ✓ *To quality determination of food materials.*
- ✓ *Apply the sensory knowledge to judge quality of food*
- ✓ *To understand the different technique of sensory analysis.*

PRACTICES:

- Experiment to score the flavors based on paired comparison test;
- Experiment to score the flavors based on duo-trio test;
- Experiment on sample preparation with varying percentage of ingredients for flavor formulation;

COURSE OUTCOMES:

The students will be able to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the food products on the basis of sensory quality parameter	Apply	1	1,2
2	Analyze the sensory properties using advanced instrument.	Apply	2	1,2,34,5
3	Develop the techniques to judge the quality of food products.	Analyze	1	1,2,3,4
4	Apply the sensory knowledge on development of new food product.	Analyze	2	1,2,3,4,7
5	Analyze the Colour, Texture, flavour, Taste of food products.	Analyze	2	1,2,3,4,7

TEXT BOOKS:

1. Amerine, M.A., Pangborn, R.M. and Rossles, E.B. 1965. Principles of Sensory Evaluation ofFood. Academic Press, London.
2. Early, R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.

REFERENCE BOOKS:

1. Jellinek, G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
2. Lawless, H.T. and Klein, B.P. 1991. Sensory Science Theory and Applicatons in Foods. MarcelDekker.

22FT816 BEVERAGE TECHNOLOGY

Source: https://www.foodprocessing.com.au/content/materials-handling-storage-and-supply-chain/article/8-technologies-for-the-food-and-beverage-industry-1275250813

Hours Per Week :

L	T	P	C
2	-	2	3

PREREQUISITE KNOWLEDGE: Basics of technology involved in carbonated, non-carbonated and fermented beverages preparation.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with different types of beverages, their manufacturing and processing technologies. The objective of this course is to enable students to describe and characterize production methods of both alcoholic and non-alcoholic beverages, basic concepts of their quality parameters and use of laboratory techniques to analyze and measure important physicochemical parameters of beverages.

MODULE - 1

UNIT-1 **14L+0T+0P=14 Hours**

INTRODUCTION TO CARBONATED AND NON-CARBONATED BEVERAGES:

Introduction: Definition of beverage; their importance; Status of beverage industry in India; Classification of beverages; Manufacturing technology (Process flow chart) for juice-based beverages; Synthetic beverages; Specialty beverages based on tea, Coffee, Cocoa, Spices, Plant extracts, Herbs, Nuts, Dairy and Imitation dairy-based beverages; Carbonation: Different methods of carbonation, ways of carbonation

UNIT-2 **2L+0T+16P=18 Hours**

CARBONATED AND NON CARBONATED BEVERAGES:

Role of various ingredients of soft drinks; Carbonation of soft drinks; Preparation of regional fruit juices; preparation of iced and flavored tea beverage; Technology involved in preparation of still, Carbonated, Low-calorie, Dry beverages, Isotonic and Sports drinks

PRACTICES:

- Demonstrate selection of equipments and machineries for food and beverage industry, maintenance of equipments, troubleshooting and repair of machineries.
- Analyse water sample and explain the techniques of purification of water for preparation of packaged drinking water.
- Demonstrate extraction of fruits, addition of sugar & preservatives as per standards and utilization of industry wastes.
- Evaluate processing of Non Alcoholic Beverages (Tea and Coffee) as per standards.

MODULE - 2

UNIT-1 **12L+4T+0P=16 Hours**

PACKAGED DRINKING WATER AND ALCOHOLIC BEVERAGES:

Packaged drinking water: Manufacturing processes of packaged drinking water; Quality evaluation; Methods of water treatment; BIS quality standards of bottled water; Mineral water; Natural spring water; Flavoured water; Carbonated water.

Types; Manufacture; Quality evaluation of alcoholic beverages; Technology of brewing process; Beer manufacturing; Role of yeast in beer and other alcoholic beverages; Types of beer (Ale type beer, Lager type beer etc.). Wine, Types of wines, Equipment required, Preparation, Problems.

Equipment's used for brewing and distillation. Different distilled spirits, their source and alcohol percentages. Sparkling clear wine Champagne, Cider, Fortified wines: Sherry, Vermouths, Orange wine, Perry, Tokay, Port, Cashew wine/ Brandy (Fenni), Neera, Toddy, Arrack.

SKILLS:

- ✓ *Use laboratory techniques to analyze and measure important physico-chemical parameters of beverages.*
- ✓ *Prepare flow chart for industrial production of beverages.*
- ✓ *Select proper ingredients for preparation of beverages.*
- ✓ *Perform subjective and objective quality analysis.*

UNIT-2 **4L+12T+0P=16 Hours**

FERMENTED FRUIT BEVERAGES:

Chemical and microbiological analysis of raw water quality; Determination of hardness of raw water; Preparation of wine and beer; Preparation of soymilk, fruit milkshakes, herbal beverages; Preparation of whey-based beverages

PRACTICES:

- Preparation of fermented fruit beverage
- Evaluate preparation, packaging, labelling and storage of carbonated water and carbonated non - alcoholic drinks as per standard.
- Demonstrate commercial processing of various alcoholic beverages viz. beer, whisky, wine etc. as per standards.
- Explain the preventive approach to food safety from biological, chemical, and physical hazards in production processes based on FAO, WHO, ISO etc., standards.
- Check WVTR, thermal resistance, bursting, tensile, tearing strengths and drop test during bottling and packaging of processed products.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the techniques involved in the production of different beverages.	Apply	1	1, 2, 3, 4
2	Understand quality standards and specifications of beverages.	Apply	1	1, 2, 5, 6
3	Gain knowledge about different categories of beverages.	Apply	1	1, 2, 3, 5
4	Know physico-chemical properties of beverages	Analyze	2	1, 2, 4, 5
5	Study sources and purchase mechanism for food commodities/ products.	Analyze	2	1, 3, 4

TEXT BOOKS:

1. W. A. Hardwick, “Handbook of Brewing”, 1st edition, Marcel Dekker, 1995.
2. Y. H. Hui, “Handbook of Food and Beverage Fermentation Technology”, 2nd edition, Marcel Dekker, 2004.

REFERENCE BOOKS:

1. F. G. Priest and G. G. Stewart, “Handbook of Brewing”, 2nd edition, CRC, 2006.
2. David Kilcast, Persis Subramaniam, “Food and beverage stability and shelf-life”, WP, 2000.
3. P.R.Ashurst, “Chemistry and technology of soft drinks and fruit juices”, CRC, 2003.

22FT817 EMERGING TRENDS IN FOOD PROCESSING

Source : https://apal.org.au/cold-plasma-post-harvest/

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Basics of novel technologies in food processing and its applications.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with recent novel food process technology, included operation and principles. The objective of this course to make students understand the recent novel advances in food processing, concepts of high pressure, pulsed electric field and its application in processing.

MODULE-1

UNIT-1 **12L+6T+0P=18 Hours**

SCOPE OF EMERGING TECHNOLIGIES:

Introduction: Use of high pressure to improve food safety and stability; Effects of high pressure on food quality - pressure effects on microorganisms, enzyme, texture and nutrients of food; Modelling HP processes; PEF Historical background; PEF treatment systems; Main processing parameters; PEF for processing of liquid foods and beverages; PEF processing for solid foods.

UNIT-2 **8L+8T+0P=16 Hours**

PRINCIPLE AND APPLICATIONS OF HPP AND PEF:

Principles of high-pressure processing; PEF mechanisms of action - mechanisms of microbial and enzyme inactivation.

PRACTICES:

- Applications of HPP in beverage industry;
- Design and analysis of pulsed electric field processing for microbial inactivation in coconut water;
- Applications of PEF in solid and liquid foods.
- Numericals on high pressure processing.

MODULE-2

UNIT-1 **12L+6T+0P=18 Hours**

PRINCIPLE AND APPLICATION OF DIFFERENT EMERGING TECHNOLOGIES IN FOOD PROCESSING:

Radio frequency electric fields equipment's; Ultrasound processing - fundamentals of ultrasound, ultrasound as a food preservation and processing; Microwave heating - dielectric properties of foods; Radiofrequency processing - dielectric heating, material properties and Ohmic heating; RFEF non-thermal inactivation of yeasts, bacteria and spores

UNIT-2 **4L+10T+0P=14 Hours**

WORKING MECHANISM AND APPLICATIONS:

Mechanism of osmotic dehydration; Thermal membrane concentration of liquid foods and colors; Effect of process parameters on mass transfer; Determination of moisture and solid diffusion coefficient; Osmotic membrane distillation; Direct osmosis; Membrane modules;

PRACTICES:

- Application of NaCl solutions for an osmotic dehydration process in onion slices and measure the moisture loss and solid gain;
- Application of reverse osmosis as membrane filtration in soda processing;

SKILLS:

- ✓ *Suggest a system, component or process to effect zero color change after processing.*
- ✓ *Estimate osmotic dehydration time for different food products.*
- ✓ *Design the processing line for HPP*

- Ultra sound assisted extraction of oil from groundnut oil seeds;
- Microwave assisted drying of medicinal leaves.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of various emerging trends in food processing	Apply	1	1, 2, 5, 6
2	Develop a technique to determine least affecting technology on colour of food.	Apply	1	1, 2, 3, 5
3	Analyze issues in public health protection related to emerging food processing	Apply	1	1, 2,3,6
4	Investigate effect of emerging processing techniques on chemical composition of food.	Analyze	2	1, 2, 4, 5

TEXT BOOKS:

1. D. W. Sun, “Emerging Technologies for Food Processing”, Academic Press, 2005.
2. G. V. Barbosa-Canovas, M. S. Tapia, and M. P. Cano, “Novel Food Processing Technologies”, CRC Press, 2004.

REFERENCE BOOKS:

1. T. Ohlsson, and N. Bengtsson, “Minimal Processing Technologies in the Food Industry”, Woodhead Publishing Limited, 2002.
2. Jasim Ahmed, Stefan kasapis, “Novel processing effects on rheological and functional properties of food” CRC press, 2005.
3. Gustavo V, Marfa S Tapia, M.Pilar Cano “Novel food processing technologies” , CRC Press, 2008.

22FT818 EXTRUSION TECHNOLOGY

Source: https://www.indiamart.com/proddetail/pasta-making-machine-8201496373.html

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE : Processing of Cereal, Food Chemistry.

COURSE DESCRIPTION AND OBJECTIVES:

To impart knowledge to the students about extrusion technology, principle of working, classification of extruders according to process and construction, extruded products and their processing.

MODULE-1

UNIT-1 **8L+6T+0P=14 Hours**

INTRODUCTION TO EXTRUSION TECHNOLOGY:

Extrusion: Definition, and introduction to extruders and their principles; Extruders in the food industry - history and uses of extruders in the food industry; Types of Extruders-Cold and Hot extrusion;

Single and Twin-screw extruders: Principle of working, net flow, factors affecting extrusion process, co-kneaders; Counter and co-rotating twin screw extruder-limitations; Pre-conditioning- pre-conditioning operations and benefits of preconditioning and devolatilization; Interpreted flight expanders -extruders, dry extruders; Post extrusion processes; Type of cooking methods-high shear cooking process, steam cookers, low shear, low pressure cookers and continuous steam pre-cooking, available brands; Breakfast cereals-Introduction, classification of breakfast cereals (i.e., flaked cereals, oven puffed cereals, gun puffed cereals, shredded products);

UNIT-2 **8L+10T+0P=18 Hours**

APPLICATIONS OF EXTRUSION TECHNOLOGY:

Application of cold extrusion in the development of various functional food product development. Practical considerations in extrusion processing - pre-extrusion processes, cooker extruder profiling. Practical considerations in extrusion processing-addition and subtraction of materials, shaping and forming at the die, post extrusion processes. Evaluating the Chemical and nutritional changes in various break-fast cereals products after extrusion. Evaluating the influence of pre-conditioning treatment of raw materials on extruded products.

MODULE-2

UNIT-1 **12L+4T+0P=16 Hours**

DESIGN OF EXTRUDER:

Extruder design: Process characteristics of the twin screw extruder - feeding, screw design, screw speed, screw configurations, die design; Twin screw extruder processes-barrel temperature and heat transfer, adiabatic operation; heat transfer operations and energy balances during extrusion.

Novel approaches: Carbon dioxide or Nitrogen assisted extrusion technology; Extrusion in confectionary technology; Non-thermal Extrusion of Protein Products.

UNIT-2 **4L+12T+0P=16Hours**

DESIGN AND DIFFERENT TECHNOLOGIES OF EXTRUDER:

Design of extruders to produce the break-fast cereal based extruded products. Evaluating the processing characteristics of extruder on the quality of products. Comparative studies on the Chemical and nutritional changes in various food products after advanced and traditional extrusion technologies. Texturized vegetable protein - Manufacturing process and quality parameters. Snack food extrusion-direct expanded (DX), Third generation (3G) snacks (i.e., types, available brands, co-extruded snacks, and indirect-expanded products).

SKILLS:

- ✓ *Formulate different extruded food products.*
- ✓ *Implement the planning strategy for production of extruded food products from carbohydrate sources.*
- ✓ *Evaluate the marketing planning for food products*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of extrusion processing for product development.	Apply	1	1, 3, 5
2	Design extruder features and analyse product characteristics.	Apply	1	1, 2, 3, 5
3	Development of food with various shape texture and sensory acceptance.	Apply	1	1, 2, 4, 5
4	Analyze and design extrusion process condition.	Analyze	1	1, 2, 5
5	Investigate and analyse quality parameters of breakfast cereals, textured V protein and third generation snacks.	Analyze	2	1, 2, 3, 4

TEXT BOOKS:

1. P.Richardson, “Thermal Technologies in food processing”, Wood Head publishers, Cmbridge, 1994.
2. R. Guy, “Extrusion Cooking: Technologies and applications”, Wood Head publishing limited, Abington, Cambridge, 1996

.

REFERENCE BOOKS:

1. R.B. Fast and E.F. Caldwell, “Breakfast Cereals and how they are made”, AACC. St. Paul, Minnesota, 2000.
2. N.D. Frame, “The Technology of Extrusion Cooking”, Blackie Academic & Professional, New York, 1994.

22FT819 MEAT, FISH AND POULTRY PROCESSING TECHNOLOGY

Image Source : https://www.smartparenting.com.ph/life/food/delivery-fresh-meat-poultry-seafood-dairy-a00041-20200325dairy-a00041-20200325

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Processing and preservation of meat, fish and poultry products.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the various sources of animal foods such as meat, fish and poultry, technology involved in their value addition, preservation and storage. The objective of this course is to make students aware of various processing technology. Equipment's, handling and quality standards of meat, fish and poultry products.

MODULE-1

UNIT-1 **12L+0T+6P=18 Hours**

MEAT PROCESSING AND PRESERVATION:

Introduction to Meat: Scope of meat, poultry and fish industry in India - Current levels of production, consumption;

Structure and composition - muscle tissue, skeletal muscle, skeletal muscle fibre, myofibrils, myofilaments, smooth muscle, cardiac muscle; Fresh meat quality parameters;

Slaughtering and stunning of meat - mechanical, electrical, chemical methods, ritual/religious methods of slaughter, jewish, halal, jhatka and spanish methods;

Processing and Preservation - chilling, freezing, curing, thermal processing, canning, dehydration, irradiation.

UNIT-2 **4L+0T+10P=14 Hours**

PROCESSING AND PRESERVATION:

Demonstration of Post mortem changes of meat; Demonstration of Comminution, Emulsification, Smoking, Cooking, Ageing, Tenderization processes; Preparation of Restructured meat products by tumbling, massaging, chunking, forming, tearing and forming, Preparation of Value added meat products - luncheon meats, meat patties, meat loaves, meat balls and meat nuggets.

PRACTICES:

- Demonstration of slaughtering and different cuts in meat at a slaughter house.
- Preparation of different types of meat products and their quality evaluation.
- Cutting of meat
- Preparation of sausages
- Calculation of size and shape index of egg
- Preparation of ready to cook poultry
- Retail cuts of dressed chicken

MODULE–2

UNIT-1 **12L+0T+4P=16 Hours**

POULTRY AND FISH PROCESSING:

Inspection of birds; Classification, Composition and nutritional value of poultry meat;

Basic properties of egg - structure, composition, nutritional and functional characteristics of eggs; Grading; Spoilage; Storage; Quality and safety considerations; Fish as raw material for processing; Biochemical composition; Factors affecting the quality of product

SKILLS:

- ✓ *Analyze the chemical composition and other sensory properties of meat.*
- ✓ *Suggest suitable processing methods for meat, fish and poultry products.*
- ✓ *Propose storage conditions for meat products and identify spoilage.*
- ✓ *Specify packaging solutions for efficient transportation of meat, fish and poultry*

UNIT-2 **8L+8T+0P=16 Hours**

PRESERVATION AND PROCESSED PRODUCTS:

Processing of shell-fish, crabs, oysters, lobsters and fish-filleting; Preparation of Value added fish products. - production of fish paste, fish oils, sauce, fish protein concentrates; Demonstration of by-products of fish processing industry; Processing of eggs for preparation of liquid products (white, yolk and whole egg) and solid products (albumen powder and whole egg powder); Demonstration of freezing, canning, salting & drying of fish. Demonstration of preservation of eggs through freezing & drying. (Candling, coating of eggs using lime, oil. etc.)

PRACTICES:

- Calculation of hogg unit of egg
- Measurement of air cell of egg
- Determination of specific gravity of egg
- Candling and grading of egg
- Preparation of meat, fish & egg pickle
- Determination of filtering & staking of fish

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Ability to apply basic food preservation principles and processing on meat, fish and poultry products.	Apply	1	1, 3, 4,
2	Investigate the impact of various methods of preservation of muscle food	Apply	1	1, 2, 3, 4
3	Analyze the effect of different composition, nutritive value on spoilage and factors affecting the spoilage of meat, fish and poultry.	Analyze	1	1, 2, 5
4	Design and Development of processing to minimize waste and by-product utilization	Create	2	1, 3, 5

TEXT BOOKS:

1. G. C. Mead, “Poultry Meat Processing and Quality”, Woodhead Publishing, 2004.
2. C. G. Scanes, G. Brant, and M. E. Esminger, “Poultry Science”, Prentice Hall, 2004.
3. R. Martin, R. Collete, and J. Slavin, “Fish Inspection, Quality Control and HACCP”, Technomic Publishing Co., 1997.
4. B. D. Sharma, “Meat and Meat Products Technology”, 1st edition, Jaypee Brothers Medical Publishers Pvt. Ltd, 1999.
5. NIIR Board of Consultants, “Preservation of Meat and Poultry”, 2nd edition, Asia Pacific Business Press Inc, 2005.

REFERENCE BOOKS:

1. L. M. L. Nollet, and F. Tolbra, “Advanced Technologies of Meat Processing”, CRC Press, 2006.
2. R. A. Lawrie, “Meat Science”, Paragoan Press, 7th edition, Oxford, New York, 2006.
3. S. Sharma, “Modern Abattoir Practices and Animal by - Products Technology”, 2nd edition, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2005.
4. Y. H. Hui, “Meat Processing and Meat Products Hand Book”, 2nd edition, CRC press, Taylor & Francis, New York, 2012.
5. W. J. Stadel, ý D. Newkirk and L. New, “Egg Science and Technology”, 4th edition, CBS Publishers, New Delhi, 1995.

22FT820 POST HARVEST MANAGEMENT OF FRUITS AND VEGETABLES

Source: https://fruitveg.com.au/wp2/product/cherry-tomatoes-cardboard/

Hours Per Week :

L	T	P	C
2	2	-	3

PREREQUISITE KNOWLEDGE: Fruits and Vegetables.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with post-harvest handling and changes of fruits and vegetables. The objective of this course is to impact knowledge to students on physico-chemical properties, handling, processing, preservation and storage of fruits and vegetables.

MODULE - 1

UNIT-1 **15L+0T+0P=15 Hours**

MATURITY & HARVESTING OF FRUITS AND VEGETABLES:

General introduction: Importance & scope of post-harvest management of fruits and vegetables in Indian economy; Morphology, structure and composition and physical properties of fruits and vegetables; Maturity indices - standards for selected fruits and vegetables, methods of maturity determinations.

UNIT-2 **5L+0T+20P=25 Hours**

POST-HARVEST CHANGES AND HANDLING:

Harvesting and handling: Harvesting tools and their design aspects; Post-harvest handling system for fruits and vegetables of regional importance such as citrus, mango, banana, pomegranate, papaya, tomato, onion, and carrot etc. primary processing for sorting and grading at farm and cluster level; Factors affecting post-harvest losses. Postharvest changes: Postharvest physiological and biochemical changes in fruits and vegetables.

PRACTICES:

- Practice judging the maturity of various fruits and vegetables
- Determination of Total Soluble Solids (TSS)
- Identification of equipment and machinery used in the preservation of fruits and vegetables
- Grading of procured fruits & vegetables based on quality requirements
- Estimation of Ascorbic Acid
- Development of quality specification manual for fruits & vegetables.

MODULE - 2

UNIT-1 **20L+0T+0P=20 Hours**

PRE-TREATMENTS:

Pre-treatment: Chemicals; Pre-packaging; VHT and irradiation; Physiological postharvest disorders - chilling injury and disease; Prevention of post-harvest diseases and infestation

UNIT-2 **0L+20T+0P=20 Hours**

TRANSPORTATION, PACKAGING & STORAGE:

Packaging system for fruits and vegetables of regional importance; Principles of transport and commercial transport operations. Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents, and natural plant products. Storage systems ambient temperature storage, ventilated, refrigerated and freezing, MAS, CA storage

SKILLS:

- ✓ *Extend the green life and freshness of fruits and vegetables.*
- ✓ *Identify and develop processing technology for specific fruits and vegetables.*
- ✓ *Handle fruits and vegetable processing equipment.*
- ✓ *Suggest suitable storage conditions for fruits and vegetables*

PRACTICES:

- Identify the prepackaging and protective treatments of a given sample.
- Estimation of transpiration, the respiration rate of fruits
- Suggest suitable storage conditions for fruits and vegetables by visiting cold storage, CA storage and MA storage units.
- Application of edible waxing to fruits & vegetables and check its quality parameter
- Preparation of Squash, dehydrated fruits and preserve, and store it in respective storage conditions.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the fundamental physico-chemical properties in processing.	Apply	1	1, 2
2	Analyze the harvesting and handling for maximum shelf-life.	Apply	1	1, 2, 5
3	Create system to minimize post-harvest changes.	Apply	1	2,3
4	Investigate effect of pre-treatments on shelf-life and final products.	Analyze	2	1, 2
5	Design new required packaging system to inhibit any mechanical damage.	Analyze	2	1, 2

TEXT BOOKS:

1. A. A. Kadar, “Post-Harvest Technology of Horticultural Crops”, 2nd edition, University of California, 1992.
2. R. P. Srivastava and S. Kumar, “Fruit and Vegetable Preservation: Principles and Practices”, 3rd edition, 2015.

REFERENCE BOOKS:

1. D. K. Salunkhe and S. S. Kadam, “Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing”, 1st edition, CRC Press, 1995.
2. N. K. Jain, “Global Advances in Tea Science”, 1st edition, Aravali Books International, 1999.
3. M. N. Clifford and K. C. Willson, “Coffee: Botany, Biochemistry and Production of Beans and Beverage”, 1st edition, AVI publishing Co., 1985.

22FT821 SPICES AND PLANTATION CROP PROCESS TECHNOLOGY

Source : https://www.agrifarming.in/spice-farming-cultivation-practices

Hours Per Week :

L	T	P	C
2	-	2	3

PREREQUISITE KNOWLEDGE: Food Chemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course details with processing, packaging and storage of different kinds of spices and condiments. The objective of this course is to make students aware of various techniques involved in processing of spices and condiments, their value addition.

MODULE–1

UNIT-1 **13L+0T+0P=13 Hours**

MAJOR AND MINOR SPICES:

Types of spices; Production of spice in India and world-wide; Bioactive compounds; Storage and packaging of spices; Spice powder – Cryogenic grinding; Spice oils and oleoresins – methods, processing; Major Spice – Harvesting, post-harvest processing production status and packaging of Turmeric, Chilli, Pepper and Onion; Minor Spice - Harvesting, post-harvest processing production status and packaging of Cardamom, Clove, Cumin, Coriander, Cinnamon, Nutmeg, Mace, Ginger, Garlic, Saffron, Vanilla.

UNIT-2 **3L+0T+16P=19Hours**

PROCESSING AND PRESERVATION OF MAJOR AND MINOR SPICES:

Adulteration of major and minor spices, Unit operations in Turmeric, Chilli, Pepper, Onion, Cardamom, Clove, Cumin, Coriander, Cinnamon, Nutmeg, Mace, Ginger, Garlic, Saffron, Vanilla processing, On-farm gadgets for major and minor spice processing, Quantification of bioactive compounds in spice industry

PRACTICES:

- Identification of several spices with their bioactive compounds
- Extraction and utilization of essential oils and oleoresin from different major and minor spices
- Identification of adulteration in the spices
- Unit operations in processing of spices
- Processing and preservation of spice powders and spice mix
- New Product Development from major and minor spices
- Extraction and quantification of antioxidant and polyphenol content in spice

MODULE–2

UNIT-1 **14L+0T+0P=14 Hours**

PLANTATION CROP PROCESS TECHNOLOGY:

Tea: Types and varieties, post-harvest processing of Tea, **Coffee**: Processing of coffee cherries by wet and dry methods, Storage and preparation of coffee brew, Cocoa: Processing of **Cocoa**; Roasting, alkalization, cracking and fanning, nib grinding for cocoa liquor, Cocoa butter and cocoa powder, Manufacturing process for chocolate, **Coconut**: Processing and its benefits, Processing of Virgin coconut oil, **Cashew nut**: Processing.

SKILLS:

- ✓ *Identify different bioactive compounds present in plantation crops.*
- ✓ *Evaluate process changes in spice and plantation.*
- ✓ *Develop new methods for measurement of different bioactive compounds.*
- ✓ *Evaluate different flavoring and aroma compounds present in spices.*
- ✓ *Analyze chemical composition of spices and plantation crops.*
- ✓ *Suggest a technology for extraction of essential oil from different spices.*
- ✓ *Identify adulteration in spice and plantation products.*

UNIT-2 **2L+0T+16P=18 Hours**

PROCESSING OF PLANTATION CROP:

Identification and preparation of different tea based on fermentation, Storage of tea, Instant tea, Use of chicory in coffee, Decaffeinated coffee, Processing of coconut oil, Different by-products obtained from cashew, Processing of by-products.

PRACTICES:

- Grades of tea
- Processed tea products
- Processing of coffee based on different Brewing Technique
- Processing and packaging of chocolate
- Product development from different parts of the coconut
- Identification of adulteration in plantation crops

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Design, develop and apply appropriate techniques for post-harvest processing of spices and specialty products.	Apply	1	1, 2
2	Apply the fundamentals of mechanical processing for value addition in spices, condiments and plantation crops.	Apply	1,2	1, 2, 5
3	Analyze the scope, processing methods and production scenario of spices and plantation crops.	Analyze	1,2	1, 2
4	Analyze the post-harvest processing of plantation crops.	Analyze	2	1, 2
5	Analyze the adulteration and select ideal packaging solutions for spice, plantation crops and condiments.	Analyze	1,2	2,3

TEXT BOOKS:

1. K. G. Shanmugavelu, “Spices and Plantation Crops”, 1st edition, Oxford and IBH Publishing Co., 1979.
2. S. Gupta, “Hand Book of Spices and Packaging with Formulae”, 2nd edition, Engineers India Research Institute, 2002.

REFERENCES:

1. D. K. Salunkhe and S. S. Kadam, “Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing”, 1st edition, CRC Press, 1995.
2. N. K. Jain, “Global Advances in Tea Science”, 1st edition, Aravali Books International, 1999.
3. M. N. Clifford and K. C. Willson, “Coffee: Botany, Biochemistry and Production of Beans and Beverage”, 1st edition, AVI publishing Co., 1985.

22FT822 WASTE MANAGEMENT AND BY-PRODUCT UTILIZATION

Source : https://www.pinterest.com/pin/global-food-waste-management-market-size-share-industry-forecast-20192025--840484349190535267/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basics of food waste management and usage of by-products.

COURSE DESCRIPTION AND OBJECTIVES:

This course deal with understanding various types of by-products and waste produced from food industry, their management and minimization. Impart knowledge to the students about waste minimization, utilization and development of various techniques to get best out of food industry waste. Gain knowledge about the advanced waste management system. Gain knowledge about the various alternative way of waste management.

MODULE-1

UNIT-1 **12L+6T+0P=18 Hours**

FOOD WASTE MANAGEMENT AND OPERATIONS IN WASTE WATER TREATMENT:

Food industry wastes; Necessity of food waste utilization; Environmental legislation; Waste water treatment practices - removal and recovery of solids in process water and reuse water within the processing plant; Water stream segregation of dissolved and particulate solids.

UNIT-2 **4L+10T+0P=14 Hours**

IMPLEMENTATION OF LAWS FOR WASTE MANAGEMENT:

Implementation of ISO 14001 standards; Environmental best practice technologies for waste minimization; Demonstration of advanced waste water treatment practices; Efficient membranes use.

PRACTICES:

- Power supply arrangements.
- Selection of motors for domestic appliances.
- Demonstration about the welding equipment.

MODULE-2

UNIT-1 **12L+4T+0P=16 Hours**

TECHNIQUES TO REDUCE FOOD WASTE AND USES OF BY-PRODUCTS:

Use of chlorine for water treatment; Anaerobic digestion of organic residues and wastes; Utilization of plant by products - for the recovery of proteins, dietary fibers, anti-oxidants and their use as nutraceuticals; Anaerobic degradation of animal by- products and utilization of whey

UNIT-2 **4L+12T+0P=16Hours**

UTILIZATION OF BY-PRODUCTS OF FOOD INDUSTRIES:

Composting and incineration of food plant waste. Demonstration on Zero discharge system; Demonstration on Zero-emission system; Waste water treatment of brewery, Winery and distillery; Effluent treatment - BOD and COD treatment and disposal of effluents

PRACTICES:

- Treatment of waste according to standards.
- Design procedure for waste treatment.
- Design alternative techniques for waste treatment.
- Ability to utilize by product from food industry

SKILLS:

- ✓ *Treatment of waste according to standards.*
- ✓ *Design procedure for waste treatment.*
- ✓ *Design alternative techniques for waste treatment.*
- ✓ *Ability to utilize by product from food industry*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the fundamental knowledge to reduce waste creation.	Apply	1	1, 2, 7, 9
2	Analyze types of operation in waste-water treatment.	Apply	1	1, 2, 5, 6, 7
3	Create alternative approach to reduce food waste	Apply	1	1, 2, 3, 6, 7
4	Design new composite materials from food waste	Apply	1	1, 3, 6, 7
5	Investigate efficiency of anaerobic digestion.	Analyze	2	1, 2, 7

TEXT BOOKS:

1. V. Oreopoulou and W. Russ, “Utilization of By-Products and Treatment of Waste in the Food Industry”, 3rd Volume, Springer, 2007.
2. K. Waldron, “Handbook of Waste Management and Co-Product Recovery in Food Processing”, 1st Edition, CRC, 2007.

REFERENCE BOOKS:

1. R. Smith, J. Klemes and J. Kim, “Handbook of Water and Energy Management in Food Processing”, 1st Edition, CRC, 2008.
2. V.K.Joshi, S.K. Sharma “Food processing waste management urilization and processing technology” 2nd edition, CRC, 2004.
3. NIIR Board, “Modern Technology of Agro Processing and Agricultural Waste Products”, 1st edition, National Institute of Industrial Research Publisher, 2001.

MINOR COURSES

FOOD TECHNOLOGY

B.Tech.

22FT901	-	Principles of Food Preservation and Processing
22FT902	-	Fruits and Vegetables Processing
22FT903	-	Dairy Technology
22FT904	-	Bakery and Confectionery Technology
22FT905	-	Food Safety and Quality Management

COURSE CONTENTS

I SEM & II SEM

22FT901 PRINCIPLES OF FOOD PRESERVATION AND PROCESSING

Source : https://greentumble.com/how-to-preserve-food-for-years/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of food preservation, classification, application, advantages and limitations.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the basic principles involved in food preservation methods. The objective of this course is to provide students with the knowledge of basic food preservation principles and processing methods to control food spoilage and deterioration.

MODULE-1

UNIT-1 **20L+0T+0P=20 Hours**

INTRODUCTION TO FOOD PRESERVATION TECHNIQUES:

History, Scope and principles of food preservation; Preservation Methods- preservation by low temperature- processing, mechanism, refrigeration, chilling, freezing, freezing curve, changes occurring during freezing, types of freezing, thawing, and its effects.

Preservation by high temperature: Different thermal operations-sterilization, pasteurization, blanching, and UHT processing; Canning- different unit operations involved, canning equipment, types of canning containers; Thermal destruction of Microorganisms – D value, F- value, Z-value.

Chemical food preservation: Types of chemical preservatives used to preserve the food and its functions; Permissible limits and safety aspects of using chemical preservatives.

UNIT-2 **4L+0T+16P=20 Hours**

APPLICATION OF FOOD PRESERVATION:

Membrane Processing: General principles and advantages, dead end and cross flow, Classification of membrane system: Reverse Osmosis, Nano Filtration, Ultra Filtration, Micro Filtration, Electo-dialysis and Pervaporation.

PRACTICES:

- Preparation of product by using Salt as preservative (any two).
- Preparation of product by using Sugar as a preservative (any two).
- Identification of spoiled food.
- Preparation of product by using Oil as preservative (any two).
- Preparation of product by using Chemical Preservative (any two).
- Separate the residues from the milk by application of microfiltration.
- Separate the dissolved salt from sea water by application of reverse osmosis
- Case studies on thermal destruction of microorganisms: D, F and Z- value.

SKILLS:

- ✓ *Identify appropriate processing and preservation method for a given food.*
- ✓ *Identify and suggest suitable food additive for a given food product.*
- ✓ *Troubleshoot problems related to food safety during food processing.*

MODULE-2

UNIT-1 **20L+0T+0P=20 Hours**

NOVEL FOOD PROCESSING TECHNIQUES:

Irradiation, Microwave, Radio-frequency, High-pressure processing, Pulsed electric field, Hurdle technology, Ohmic heating, UV light, Cold plasma.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATION OF NOVEL FOOD PROCESSING TECHNIQUES IN FOOD PRESERVATION:

Food preservation by natural antimicrobials agents from plant; modified-atmosphere packaging; vacuum packaging aseptic processing; ultrasound.

PRACTICES:

- Drying of Vegetable (any two) by application of microwave
- Increasing the juice yield by application of ultrasound
- Development of hurdle technology for fermented foods
- Development of vacuum packaging for sea foods
- Application of antimicrobial agents in cut fruits and evaluate the quality.
- Development of fruit squash by application by aseptic processing
- Surface decontamination of vegetables by application UV light.
- Determination of textural properties of food treated with antimicrobial agents

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various physical, chemical and biological methods of food preservation to extend shelf life of food.	Apply	1,2	1,2,3,4
2	Use the principle of low-temperature preservation to avoid food spoilage.	Apply	1	1,2,3,4,5
3	Formulate thermal process conditions to attain sterility and ensure safe food.	Apply	1	2,3,4,8
4	Identify chemical preservatives and their safe usage limit.	Apply	1,2	4,5,7
5	Apply the knowledge of various non-thermal processing techniques for food preservation.	Apply	1,2	1,2,4,5,7
6	Investigate the impact of various types of thermal processing on food preservation and analyse thermal sterilization kinetics.	Analyze	1	1,2,8

TEXT BOOKS:

1. Physical Principles of Food Preservation: Revised and Expanded, 2nd edition, Marcus Karel, Daryl B. Lund, 2008.
2. J. P. Fellows, “Food Processing Technology, Principles and Practices”, 2nd edition, Wood Head Publishing, 1999. 3. N. N. Potter and J. H. Hotchkiss, “Food Science,” 5th edition, Springer, 1998.

REFERENCE BOOKS:

1. H. Ramaswamy and M. Marcotte, “Food Processing: Principles and Applications” Hardcover, Import, 2005.
2. B. Lal, G. B. Siddappa and G. N. Tandon, “Preservation of Fruits and Vegetables,” 2 nd edition, ICAR Publication, 1967.
3. Potter N. N. and Hotchkiss J. H., “Food Science” 5th e-book edition, CBS Publishers & Distributors Pvt. Ltd. 2021.

22FT902 FRUITS AND VEGETABLES PROCESSING

Source : https://nuffoodsspectrum.in/2022/01/10/foodtech-pathshala-announces-virtual-factory-visit.html

Hours Per Week :

L	T	P	C
3	-	2	4

PREREQUISITE KNOWLEDGE: Food preservation methods.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with technologies related to handling, processing and storage of fruits and vegetables. Impart skill and knowledge required to apply the principles and concepts behind fruit and vegetable processing including post-harvest handling.

MODULE-1

UNIT-1 **20L+0T+0P=20 Hours**

INTRODUCTION TO FOOD PRESERVATION TECHNIQUES:

Current status of production and processing of fruits and vegetables; Chemical composition; Pre and postharvest changes; Role of plant growth regulators in relation to storage; Maturity standards for storage, and desirable characteristics of fruits and vegetables for processing; Conditions for transportation and storage; Post-harvest physiology

UNIT-2 **4L+0T+16P=20 Hours**

APPLICATION OF FOOD PRESERVATION:

Fruit Beverages: juice, pulp, RTS, Squash, Nectar, Cordial, Syrup, and Extract,

Jam, Jelly, Marmalade: Pectin- structure, properties and role; Determination of end point; Defects in Jam, Jelly, Marmalade; Canning: Blanching and bottling (oven dry pack, oven wet pack, slow water bath, fast water bath and pressure bottling), retorting.

PRACTICES:

- Determination of quality parameters of different fruits and vegetables processed products.
- Determination of sugar acid ratio in fruits and vegetables.
- Determination of pectin content in fruits and vegetables.
- Preparation of jam and determination of TSS and viscosity. (FSSAI Standards)
- Preparation of jelly and marmalade and determination of TSS and viscosity. (FSSAI Standards).
- Testing the adequacy of blanching.
- Clarification of juices with enzymes.

MODULE-2

UNIT-1 **20L+0P+0T=20 Hours**

MINIMAL PROCESSING OF FRUITS AND VEGETABLES:

Minimally processed fruits and vegetables: Factors affecting shelf life and the quality of minimally processed fruits and vegetables; Physiology and biochemistry of fresh cut; Preservation by freezing - general methods for freezing of fruits and vegetables, problem relating to storage of frozen products, standards for frozen fruits and vegetables; Dehydration of fruits and vegetables – methods of drying; Packaging (CA and MA storage).

UNIT-2 **4L+16P+0T=20 Hours**

FERMENTED FRUITS AND VEGETABLE PRODUCTS:

Vinegar - production, its uses and quality control checks. Pickle and chutney processing: Role of lactic acid bacteria in pickling with vinegar and fermentation, sauerkraut, kimchi.

SKILLS:

- ✓ *Specify physiological, physical, chemical and nutritional properties of fruits and vegetables.*
- ✓ *Identify the post-harvest factors that effect on shelf life of fruits and vegetables.*
- ✓ *Suggest suitable processing and storage conditions for fruit and vegetable products.*

PRACTICES:

- Determination of colour values (L, A, B, ΔE, Chroma & Hue) for food sample.
- Preparation of pickles, chutneys and their quality and cost evaluation.
- Textural properties analysis using penetrometer.
- Preparation of tomato products and their quality and cost evaluation.
- Determination of viscosity of fruit based products.
- Preparation of fruit leather and its quality and cost evaluation.
- Determination of total phenolic content and antioxidant activity by DPPH method.
- Wine and alcoholic beverage preparation.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to achieve the following outcomes:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge on processing of fruits and vegetables.	Apply	1,2	1,2,3,4
2	Develop the preservation techniques to improve the shelf life of seasonal fruits.	Apply	1	1,2,3,4,5,7
3	Apply the knowledge of canning for preservation of fruit and vegetable products.	Apply	1	1,2,8,6
4	Develop fermented fruits and vegetable food products.	Apply	1,2	3,4,5,7,
5	Analyze the factors affecting the shelf life of minimally processed foods.	Analyze	2	2,3,4,8

TEXT BOOKS:

1. R. P. Srivastava and S. Kumar, “Fruit and Vegetable Preservation - Principles and Practices”, 6th edition, International Book Distributors, 2003.
2. G. Lal, G. S. Siddappa and G. L. Tandon, “Preservation of Fruits and Vegetables”, 3rd edition. ICAR, New Delhi, 1998.

REFERENCE BOOKS:

1. H. Ramaswamy and M. Marcotte, “Food Processing: Principles and Applications” Hardcover, Import, 2005.
2. Rachna Sehrawat, Khursheed A. Khan, Megh R. Goyal and Prodyut K. Paul, “Technological Interventions in the Processing of Fruits and Vegetables” 1st edition, Apple Academic Press, 2018.

22FT903 DAIRY TECHNOLOGY

Source : https://www.motherdairy.com/

Hours Per Week :

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: Microbiology, Food Biochemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with handling, processing and preservation of milk and milk products. The objective of this course is to impart knowledge about milk, milk processing methodologies, processing equipment, by-product utilization and to bestow skills.

MODULE-1

UNIT-1 **18L+0T+0P=18 Hours**

MILK, CREAM AND BUTTER:

Milk: Basic properties of milk and its composition; Pre-processing of milk - buying and collection of milk, cooling and transportation of milk, receiving, preheating, filtration/ clarification, cooling, storage of raw milk; Pasteurization - definition, objectives, methods of pasteurization, homogenization, different liquid milk-Standard, tonned, double tonned etc. sterilized and UHT milk, bottling, and storage.

Cream: Definition; Classification; Composition; Factors affecting fat percentage of cream; Defects in cream - causes and prevention.

Butter: Definition: Classification; Composition; Method of manufacture; Packaging and storage of butter; Butter over run; Theories of churning; Continuous butter making; Defects in butter-causes and prevention.

UNIT-2 **6L+0T+16P=22 Hours**

PRACTICAL AND INDUSTRIAL APPLICATION OF MILK PRODUCTS:

Physico-chemical properties of milk; Standardization of milk; Platform test for milk; CIP methods; Detection of common adulterants present in milk; Cream production; Preparation of Butter oil from milk and butter.

PRACTICES:

- Physico-chemical properties of milk.
- Standardization of milk.
- CIP methods.
- Platform test for milk.
- Detection of common adulterants present in milk
- Preparation of Butter oil.

MODULE-2

UNIT-1: **15L+0T+0P=15 Hours**

CHEESE, ICE CREAM AND INDIGENOUS MILK PRODUCTS:

Cheese: Method of manufacture; Types of Cheese: Curing of cheese; Defects in cheese -causes and prevention; Whey processing

Dehydrated milk products- WMP, SMP, Infant Milk powders, Malted Milk Foods.

Fermented milk: Starter culture – types, propagation and defects.

Indigenous milk products: Khoa: Chhana; Paneer; Shrikhand. Ghee

Ice Cream: Definition; Classification; Composition; Nutritive value; Role of constituents in ice cream; Ice-cream Vs Frozen desserts; Method of manufacture; Packaging; Hardening and storage; Ice cream over run; Defects - causes and prevention.

SKILLS:

- ✓ *Determine physico-chemical properties of milk.*
- ✓ *Perform Standardization of milk for different products.*
- ✓ *Proficiency on processing and manufacturing methods of milk and dairy products.*
- ✓ *Identify the milk processing equipment required for a specific application*

By-products of dairy industry: Processing of by-products – whey, WPC, WPI, buttermilk, ghee residue; Processing of casein and lactose.

UNIT-2 **9L+0T+16P=25 Hours**

RULES AND REGULATION IN DAIRY PRODUCTS AND INDUSTRY:

Preparation and analysis of dairy products-FSSAI standards.

PRACTICES:

- Preparation of yoghurt and curd.
- Preparation and analysis of natural butter milk, cultured butter milk, acidophilus milk, bulgarian butter milk, kumis, kefir.
- Preparation of Special milk - flavoured, chocolate, vitaminized, irradiated and concentrated.
- Preparation of Channa based sweet & Paneer.
- Preparation of Khoa based sweets.
- Preparation of Ice cream.
- Preparation of milk powder by spray drying method.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of separation techniques for production of cream, butter, cheese, ice cream.	Apply	1,2	1, 2, 5, 9, 10
2	Analyse the composition of milk and identify various processing methods of milk.	Analyze	1,2	1, 2, 4, 5, 9, 10, 12
3	Analyse the nutritional properties of dairy products.	Analyze	2	1, 2, 3, 5, 9,
4	Evaluate the properties of various indigenous milk products	Evaluate	1,2	1, 2, 3, 4, 5, 9, 10, 12
5	Formulate of fermented and unfermented dairy-based beverages and speciality products.	Create	2	1, 2, 5, 9, 10, 12

TEXT BOOKS:

1. S. De, “Outlines of Dairy Technology”, 1st edition, Oxford University Press, 2019.
2. J. N. Warner, “Principles of Dairy Processing”, 3rd edition, Wiley Eastern Ltd., Delhi, India, 2018.

REFERENCE BOOKS:

1. K. S. Bangarappa and K. L. Acharya, “Indian Dairy Products”, 2nd edition, Asia Publishing House, Bombay,1974.
2. P. Walstra, “Dairy Science and Technology”, 2nd edition, Taylor & Francis, 2006.
3. Pieter Walstra, “Dairy Technology: Principles of Milk Properties and Processes”, CRC Press, 1999.

22FT904 BAKERY AND CONFECTIONERY TECHNOLOGY

Source: https://www.bizbuysell.com/bakeries-for-sale/3/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Cereal Processing.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with bakery and confectionery sector of food processing. The objective of this course is to acquaint the students with preparation methods for various bakery and confectionary products, quality control aspects, processing parameters and handling of equipment.

MODULE-1

UNIT-1 **18L+0T+0P=18 Hours**

BASIC CONCEPT OF BAKERY:

Global and Indian status of bakery and confectionery industry; Ingredients and their role in bakery industry (wheat flour, sugar, fat and oils, egg, yeast, salt, leavening agents, moistening agent, improvers and emulsifiers); Types of dough developed - developed dough, short dough, semi-sweet, enzyme modified dough; Importance of the consistency of the dough (straight dough, rapid processing, mechanical dough); Breads: Ingredients and process flow of preparation; Types of breads; Various faults in breads – staling of bread, losses during manufacturing; Equipment's used - make up equipment; Functions of mixing and mixer type (horizontal, vertical, planetary and continuous mixers) and blenders used in bakery industry; Divider; Rounder; Moulder; Proofer; Oven; Slicer and packaging materials used; Biscuits and Cookies: Process flow and manufacturing; Biscuits-ingredients and flour specifications; Process flow manufacturing; Types of biscuits and crackers; Faults in biscuits.

UNIT-2 **6L+0T+16P=22 Hours**

ANALYSIS OF BAKERY PRODUCTS:

Physicochemical parameters of bakery ingredients; Rheological testing of dough; Effect of process parameters on quality-biscuit and cookies; Packaging material for biscuits; Gluten free products and pasta - raw material, processing and quality parameters.

PRACTICES:

- Gluten determination of cereal flour.
- Determination of dough raising capacity.
- Water absorption index and solubility test of flour sample.
- Process flow sheet of breads Analysis of quality parameters of developed bread (textural properties, sensory analysis).
- Process flow for different types of biscuits, cookies and crackers.
- Analysis of quality parameters of developed biscuits and cookies (fat, textural properties, sensory analysis).

MODULE-2

UNIT-1 **15L+0T+0P=15 Hours**

CAKE AND CONFECTIONERY PRODUCTS:

Cakes: Ingredients; Flour specification; Process flow and quality evaluation; Faults and corrective measures; Confectionary - Raw materials used in confectionery; Chocolate processing; Miscellaneous products - Co-extruded products; Bakery plant layout; Safe practices in work-place sanitation; Code for hygienic conditions.

SKILLS:

- ✓ *Prepare commonly consumed bakery products like bread and fermented foods,*
- ✓ *Cookies, biscuits, cakes and Icing.*
- ✓ *Judge the quality of raw-materials.*
- ✓ *Predict the physiochemical changes during processing.*
- ✓ *Handling of various bakery equipment.*

UNIT-2 **9L+0T+16P=24 Hours**

PREPARATION AND PROCESSING OF DIFFERENT CONFECTIONERY PRODUCTS:

Sugar confectionery: Processing and quality assessment of cotton candy, fruit drops, centre filled toffees, caramel; lollipops; chewing gums and bubble gums; Preparation and analysis of fudges, lozenges toffees, marshmallow and fondants, 3 D food printing.

PRACTICES:

- Preparation and quality analysis of cakes, pastries, doughnuts, Pizza.
- Processing and analysis of chocolate and candy bars.
- Preparation and quality analysis of cakes, doughnuts, Pizza.
- Preparation and analysis of hard-boiled candies, centre filled toffees, caramel.
- 3D printing of confectionery products

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify various ingredients used in bakery and confectionary products	Apply	1	1, 3, 4, 5, 9, 10, 12
2	Analyse the function and interaction of carbohydrate and protein during dough development.	Analyze	1, 2	1, 2, 9, 10
3	Analyse the nutritional properties of value-added bakery and confectionary products.	Analyze	1,2	1, 2, 3, 5, 9, 10
4	Investigate the impact of processing methods on quality of baked and confectionary products.	Evaluate	1, 2	1, 2, 3, 4, 5, 9, 10, 12
5	Develop suitable method for value added bakery product development.	Create	2	1, 2, 4, 9, 10, 12

TEXT BOOKS:

1. W. J. Sultan,"Baker's Handbook on Practical Baking", 5th edition, US wheat Associates, Wiley, 2010.
2. J. Kingslee, "A Professional Textto Bakery and Confectionery", 3rd edition, New Age International, New Delhi, 2006.

REFERENCE BOOKS:

1. E. B. Jackson, "Sugar Confectionery Manufacture", 2nd edition, Springer, 1995.
2. Ashok kumar Y, "Textbook of Bakery and Confectionery: Second Edition", 2nd edition, Prentice Hall India Learning Private Limited, 2012.
3. Geoff Talbot, "Science and Technology of Enrobed and Filled Chocolate, Confectionery and Bakery Products", Woodhead Publishing Series in Food Science, Technology and Nutrition, 2009.

22FT905 FOOD SAFETY AND QUALITY MANAGEMENT

Source : https://www.kizytracking.com/fssc-22000-compliance-food-safety-standards/

Hours Per Week :

L	T	P	C
3	2	-	4

PREREQUISITE KNOWLEDGE: Food Quality, Food Microbiology, Food Toxicology.

COURSE DESCRIPTION AND OBJECTIVES:

The course deals with global food safety, security, Food laws, standards and regulations. The objective of this course is to impart knowledge to students on national and international food standards along with application of ISO and HACCP in food processing industries.

MODULE-1

UNIT-1 **18L+6T+0P=24 Hours**

FOOD SAFETY AND NATIONAL FOOD LAWS:

FOOD QUALITY: Quality attributes of food, Gustation: Mechanism of taste perception, Difference tests for sensory evaluation; Olfaction, Colour: CIE (International Commission on Illumination) color system; Image processing techniques for Food Quality Evaluation; Texture. Introduction to food safety& standards, Concept of food Hazards- Physical, Chemical and biological, Food adulteration and safety, Permitted Food additives and limits, Statistical Quality Control techniques.

UNIT-2 **6L+10T+0P=16 Hours**

INDIAN STANDARDS:

FSSAI-law, structure, working and powers, AGMARK act and rules- Certification procedure, laboratory approvals and actions on non-compliance, appeals, BIS- scope, definition, power and functions of BIS, Licensing procedure, export and import laws and regulations, Export (Quality and inspection) act 1963; APEDA& MPEDA- introduction, act and rules, functions and products monitored.

PRACTICES:

- Case study on food quality standards
- Finding hazards in food product samples: Biological hazards, Chemical hazards, Physical hazards, Trace chemicals.
- Case study on microbiological considerations in food safety.
- HACCP: Identification of CCPs, application of HACCP in food industry.
- Case study on APEDA & MPEFA

MODULE-2

UNIT-1 **12L+2T+0P=14 Hours**

INTERNATIONAL FOOD LAWS:

FAO: Overview of Organization structure, Objectives & Functions; Introduction to WHO; Codex Alimentarius commission - role of CAC and its committees; Introduction to OIE and IPPC; Introduction of other international food standards- BRC, Kosher etc. WTO - introduction to WTO agreements, SPS and TBT Agreement; Implications on trade in light of SPS and TBT.

UNIT-2 **12L+14T+0P=26 Hours**

QUALITY MANAGEMENT AND QUALITY ASSURANCE:

Total quality management, Good manufacturing practices, good agricultural practices, good laboratory practices; Quality management systems, QSS; Quality circles, SQC; ISO system. HACCP: Principles, implementation; Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors; Certification, certification procedures, certifying bodies, accrediting bodies, international bodies

SKILLS:

- ✓ *Apply different coloring matter in developing new food products.*
- ✓ *Preserve food in a synergistic manner using chelating and antioxidants.*
- ✓ *Make use of different thickening agents in modifying the food texture.*
- ✓ *Develop different variety of food products using different flavor on same basic ingredient.*
- ✓ *Determine toxicity level of each food additive.*

PRACTICES:

- Case study on quality management
- Introduction to Contents of the standards, Salient features, Advantages of implementation of the standard, Certification & Auditing;
- ISO 9001:2008 - evolution of ISO 9001:2008, Introduction to the family of ISO 22000 standards - FSMS – 22000:2005, various elements and clauses included in the standard;
- Comparison of ISO 9001:2008 vs. ISO 22000:2005.
- Implementation of HACCP in any food company.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Formulate the optimal level of food additives for various food applications.	Apply	2	1, 2, 5, 9, 10, 12
2	Analyze and identify various food additives and their safe usage limits.	Analyze	1, 2	1, 2, 5, 7, 9, 10, 11, 12
3	Analyze knowledge of naturally available food additive for food preservation.	Analyze	1	1, 2, 3, 4, 5, 6, 8,12
4	Apply the knowledge of food safety protocols to food business operators.	Analyze	2	1, 2, 3, 4, 6, 7, 8, 9
5	Analyze and identify the food hazards and risk associated with it.	Create	1	1, 2, 4, 6, 7

TEXT BOOKS:

1. C. A. Roberts, “The Food Safety Information Handbook”, 2nd edition, Oryx Press, 2001.
2. R. H. Schmidt and G. E. Rodrick, “Food Safety Handbook”, 3rd edition, John Wiley & Sons, 2005.

REFERENCE BOOK:

1. N. Rees and D. Watson, “International standards for food safety”, 1st edition, Aspen publishers, Gaithersburg, Maryland. 2000.
2. P. L. Knechtges, “Food safety: Theory and Practice”, 1st edition, Jones and Bartlett learning, UK, 2012.

HONORS/ SPECIALIZATION COURSES

B.Tech.

FOOD TECHNOLOGY

22FT951	-	Beverage Technology
22FT952	-	Emerging Trends in Food Processing
22FT953	-	Extrusion Technology
22FT954	-	Waste Management and by-Product Utilization
22FT955	-	Project

COURSE CONTENTS

I SEM & II SEM

22FT951 BEVERAGE TECHNOLOGY

Source: https://www.premiumtimesng.com/news/headlines/507916-sweetened-beverage-tax-how-policy-may-boost-nigerias-fight-against-non-communicable-diseases.html

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Basics of technology involved in carbonated, non-carbonated and fermented beverages preparation.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with different types of beverages, their manufacturing and processing technologies. The objective of this course is to enable students to describe and characterize production methods of both alcoholic and non-alcoholic beverages, basic concepts of their quality parameters and use of laboratory techniques to analyze and measure important physicochemical parameters of beverages.

MODULE-1

UNIT-1 **14L+0T+0P=14 Hours**

INTRODUCTION TO CARBONATED AND NON-CARBONATED BEVERAGES:

Introduction: Definition of beverage; their importance; Status of beverage industry in India; Classification of beverages; Manufacturing technology (Process flow chart) for juice-based beverages; Synthetic beverages; Specialty beverages based on tea, Coffee, Cocoa, Spices, Plant extracts, Herbs, Nuts, Dairy and Imitation dairy-based beverages; Carbonation: Different methods of carbonation, ways of carbonation.

UNIT-2 **2L+0T+16P=18 Hours**

CARBONATED AND NON CARBONATED BEVERAGES:

Role of various ingredients of soft drinks; Carbonation of soft drinks; Preparation of regional fruit juices; Preparation of iced and flavored tea beverage; Technology involved in preparation of Still, Carbonated, Low-calorie, Dry beverages, Isotonic and Sports drinks.

PRACTICES:

- Demonstrate selection of equipments and machineries for food and beverage industry, maintenance of equipments, troubleshooting and repair of machineries.
- Analyse water sample and explain the techniques of purification of water for preparation of packaged drinking water.
- Demonstrate extraction of fruits, addition of sugar & preservatives as per standards and utilization of industry wastes.
- Evaluate processing of Non Alcoholic Beverages (Tea and Coffee) as per standards

MODULE-2

UNIT-1 **12L+4T+0P=16 Hours**

PACKAGED DRINKING WATER AND ALCOHOLIC BEVERAGES:

Packaged drinking water: Manufacturing processes of packaged drinking water; Quality evaluation; Methods of water treatment; BIS quality standards of bottled water; Mineral water; Natural spring water; Flavoured water; Carbonated water.

Types; Manufacture; Quality evaluation of alcoholic beverages; Technology of brewing process; **Beer** manufacturing; Role of yeast in beer and other alcoholic beverages; Types of beer (Ale type beer, Lager type beer etc.). Wine, Types of wines, Equipment required, Preparation, Problems.

Equipment's used for brewing and distillation. Different distilled spirits, their source and alcohol percentages. Sparkling clear wine Champagne, Cider, Fortified wines: Sherry, Vermouths, Orange wine, Perry, Tokay, Port, Cashew wine/ Brandy (Fenni), Neera, Toddy, Arrack.

SKILLS:

- ✓ *Use laboratory techniques to analyze and measure important physico-chemical parameters of beverages.*
- ✓ *Prepare flow chart for industrial production of beverages.*
- ✓ *Select proper ingredients for preparation of beverages.*
- ✓ *Perform subjective and objective quality analysis.*

UNIT-2 **4L+12T+0P=16 Hours**

FERMENTED FRUIT BEVERAGES:

Chemical and microbiological analysis of raw water quality; Determination of hardness of raw water; Preparation of wine and beer; Preparation of soymilk, fruit milkshakes, herbal beverages; Preparation of whey-based beverages.

PRACTICES:

- Preparation of fermented fruit beverage
- Evaluate preparation, packaging, labelling and storage of carbonated water and carbonated nonalcoholic drinks as per standard.
- Demonstrate commercial processing of various alcoholic beverages viz. beer, whisky, wine etc. as per standards.
- Explain the preventive approach to food safety from biological, chemical, and physical hazards in production processes based on FAO, WHO, ISO etc standards.
- Check WVTR, thermal resistance, bursting, tensile, tearing strengths and drop test during bottling and packaging of processed products.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Understand the techniques involved in the production of different beverages.	Apply	1	1, 2, 3, 4
2	Understand quality standards and specifications of beverages.	Apply	1	1, 2, 5, 6
3	Gain knowledge about different categories of beverages.	Apply	1	1, 2, 3, 5
4	Know physico-chemical properties of beverages	Analyse	2	1, 2, 4, 5
5	Study sources and purchase mechanism for food commodities/ products.	Analyze	2	1, 3, 4

TEXT BOOKS:

1. W. A. Hardwick, “Handbook of Brewing”, 1st edition, Marcel Dekker, 1995.
2. Y. H. Hui, “Handbook of Food and Beverage Fermentation Technology”, 2nd edition, Marcel Dekker, 2004.

REFERENCE BOOKS:

1. F. G. Priest and G. G. Stewart, “Handbook of Brewing”, 2nd edition, CRC, 2006.
2. David Kilcast, Persis Subramaniam, “Food and beverage stability and shelf-life”, WP, 2000.
3. P.R.Ashurst, “Chemistry and technology of soft drinks and fruit juices”, CRC, 2003.

22FT952 EMERGING TRENDS IN FOOD PROCESSING

Source : https://emag.medicalexpo.com/five-major-trends-will-impact-the-food-industry-in-2020/

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Basics of novel technologies in food processing and its applications.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with recent novel food process technology, including operation and principles. The objective of this course to make students understand the recent novel advances in food processing, concepts of high pressure, pulsed electric field and its application in processing of foods.

MODULE-1

UNIT-1 **12L+6T+0P=18 Hours**

SCOPE OF EMERGING TECHNOLIGIES:

Introduction: Use of high pressure to improve food safety and stability; Effects of high pressure on food quality - pressure effects on microorganisms, enzyme, texture and nutrients of food; Modelling HP processes; PEF Historical background; PEF treatment systems; Main processing parameters; PEF for processing of liquid foods and beverages; PEF processing for solid foods.

UNIT-2 **4L+10T+0P=14 Hours**

PRINCIPLE AND APPLICATIONS OF HPP AND PEF:

Principles of high-pressure processing; PEF mechanisms of action - mechanisms of microbial and enzyme inactivation.

PRACTICES:

- Applications of HPP in beverage industry.
- Other applications of high-pressure processing.
- Applications of PEF in solid and liquid foods.
- Food safety aspects of pulsed electric fields and high-pressure processing.

MODULE-2

UNIT-1: **12L+6T+0P=18Hours**

CONCEPTS OF OSMOTIC AND PHYSICAL PROCESSING METHODS:

Effect of process parameters on mass transfer; Determination of moisture and solid diffusion coefficient; Osmotic membrane distillation; Direct osmosis; Membrane modules; Radio frequency electric fields equipment's; Ultrasound processing - fundamentals of ultrasound, ultrasound as a food preservation and processing; Microwave heating - dielectric properties of foods; Radiofrequency processing - dielectric heating, material properties and Ohmic heating.

UNIT-2 **4L+10T+0P=14 Hours**

WORKING MECHANISM AND APPLICATIONS:

Mechanism of osmotic dehydration; Thermal membrane concentration of liquid foods and colors; RFEF non-thermal inactivation of yeasts, bacteria and spores;

PRACTICES:

- Application of osmotic dehydration.
- Applications of membrane concentration.
- Effects of ultrasound on food properties.
- Application of microwave processing for foods.

SKILLS:

- ✓ *Suggest a system, component or process to effect zero color change after processing.*
- ✓ *Estimate osmotic dehydration time for different food products.*
- ✓ *Design the processing line for HPP*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of various emerging trends in food processing	Apply	1	1, 2, 5, 6
2	Develop a technique to determine least affecting technology on colour of food.	Apply	1	1, 2, 3, 5
3	Analyze issues in public health protection related to emerging food processing	Apply	1	1, 2,3,6
4	Investigate effect of emerging processing techniques on chemical composition of food.	Analyze	2	1, 2, 4, 5

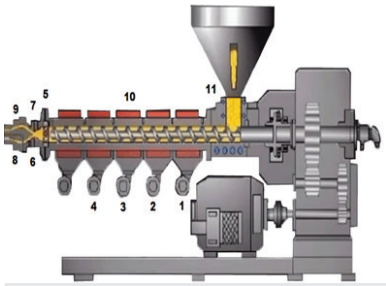
TEXT BOOKS:

1. D. W. Sun, “Emerging Technologies for Food Processing”, Academic Press, 2005.
2. G. V. Barbosa-Canovas, M. S. Tapia, and M. P. Cano, “Novel Food Processing Technologies”, CRC Press, 2004.

REFERENCE BOOKS:

1. T. Ohlsson, and N. Bengtsson, “Minimal Processing Technologies in the Food Industry”, Woodhead Publishing Limited, 2002.
2. Mohsen Gavahian, “Emerging Food Processing Technologies”, Humana New York, NY, 2022.

22FT953 EXTRUSION TECHNOLOGY



Source : https://link.springer.com/article/10.1007/s10845-018-1418-7

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Starch, Food Processing.

COURSE DESCRIPTION AND OBJECTIVES:

To impart knowledge to the students about extrusion technology, principle of working, classification of extruders according to process and construction, extruded products and their processing.

MODULE-1

UNIT-1 **10L+8T+6P=24 Hours**

INTRODUCTION OF EXTRUSION TECHNOLOGY:

Extrusion: Definition, and introduction to extruders and their principles; Extruders in the food industry - history and uses of extruders in the food industry; Types of extruders-Cold and Hot extrusion.

Single and Twin-screw extruders: Principle of working, net flow, factors affecting extrusion process, co-kneaders; Counter and co-rotating twin screw extruder-limitations; Pre-conditioning- pre-conditioning operations and benefits of preconditioning and devolatilization; Interpreted flight expanders -extruders, dry extruders; Post extrusion processes; Type of cooking methods-high shear cooking process, steam cookers, low shear, low pressure cookers and continuous steam pre-cooking, available brands; Breakfast cereals-Introduction, classification of breakfast cereals (i.e., flaked cereals, oven puffed cereals, gun puffed cereals, shredded products);

UNIT-2 **6L+8T+10P=24 Hours**

TWIN SCREW EXTRUDER:

Application of extrusion in the development of various functional food product development. Practical considerations in extrusion processing - pre-extrusion, cooker extruder profiling. Practical considerations in extrusion processing-addition and subtraction of materials, shaping and forming at the die, post extrusion processes. Evaluating chemical and nutritional changes in break-fast cereals products after extrusion. Evaluating the influence of pre-conditioning treatment of raw materials on extruded products

PRACTICES:

- Effect of Process Parameters of Extrusion on Quality of Extruded
- Effect of extrusion technology on food product
- Functional Properties of extruded food
- Effects of extrusion on physio-chemical properties
- Advantages of extrusion technology

MODULE-2

UNIT-1 **12L+8T+4P=24 Hours**

UNIT OPERATIONS & MATERIAL HANDLING IN EXTRUSION:

Extruder design: Process characteristics of the twin screw extruder - feeding, screw design, screw speed, screw configurations, die design; Twin screw extruder processes-barrel temperature and heat transfer, adiabatic operation; heat transfer operations and energy balances during extrusion.

Novel approaches: Carbon dioxide or Nitrogen assisted extrusion technology; Extrusion in confectionary technology; Non-thermal Extrusion of Protein Products.

SKILLS:

- ✓ *Formulate different extruded food products.*
- ✓ *Implement the planning strategy for production of extruded food products from carbohydrate sources.*
- ✓ *Evaluate the marketing planning for food products.*

UNIT-2 **4L+8T+12P=16Hours**

DESIGN AND DIFFERENT TECHNOLOGIES OF EXTRUDER:

Design of extruders to produce the break-fast cereal based extruded products. Evaluating the processing characteristics of extruder on the quality of products. Comparative studies on the Chemical and nutritional changes in various food products after advanced and traditional extrusion technologies. Texturized vegetable protein - Manufacturing process and quality parameters. Snack food extrusion-direct expanded (DX), Third generation (3G) snacks (i.e., types, available brands, co-extruded snacks, and indirect-expanded products).

PRACTICES:

- Design of extruders to produce the break-fast cereal based extruded products.
- Evaluating the processing characteristics of extruder on the quality of products.
- Comparative studies on the Chemical and nutritional changes in various food products after advanced and traditional extrusion technologies.
- Texturized vegetable protein - Manufacturing process and quality parameters.
- Snack food extrusion- direct expanded (DX), Third generation (3G) snacks (i.e., types, available brands, co-extruded snacks, and indirect-expanded products).

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of extrusion processing for product development.	Apply	1	1, 2
2	Analyze and design extrusion process condition.	Apply	1	1, 2, 5
3	Design extruder features and analyse product characteristics.	Apply	1	2,3
4	Development of food with various shape texture and sensory acceptance.	Analyze	2	1, 2
5	Investigate and analyse quality parameters of breakfast cereals, textured V protein and third generation snacks.	Analyze	2	1, 2

TEXT BOOKS:

1. P.Richardson, “Thermal Technologies in food processing”, Wood Head publishers, Cmbridge, 1994.
2. R. Guy, “Extrusion Cooking: Technologies and applications”, Wood Head publishing limited, Abington, Cambridge, 1996. .

REFERENCE BOOK:

1. R.B. Fast and E.F. Caldwell, “Breakfast Cereals and How they are made”, AACC., St. Paul, Minnesota, 2000.
2. N.D. Frame, “The Technology of Extrusion Cooking”, Blackie Academic & Professional, New York, 1994.

22FT954 WASTE MANAGEMENT AND BY-PRODUCT UTILIZATION

Source : https://www.theguardian.com/sustainable-business/2015/oct/01/us-cut-food-waste-kellogg-nestle-hungry-landfill

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Food processing waste, composition.

COURSE DESCRIPTION AND OBJECTIVES:

This course deal with understanding various types of by-products and waste produced from food industry, their management and minimization. Impart knowledge to the students about waste minimization, utilization and development of various techniques to get best out of food industry waste. Gain knowledge about the advanced waste management system. Gain knowledge about the various alternative way of waste management .

MODULE-1

UNIT-1 **12L+8T+4P=24 Hours**

FOOD WASTE MANAGEMENT:

Food industry wastes; Necessity of food waste utilization; Environmental legislation; Waste water treatment practices - removal and recovery of solids in process water and reuse water within the processing plant; Water stream segregation of dissolved and particulate solids.

UNIT-2 **4L+8T+12P=24 Hours**

TYPES OF WASTEWATER TREATMENT:

Septic tanks, soak pits, two-pit latrines, eco-toilet. Natural and constructed wetlands.

PRACTICES:

- Case study on Food waste management.
- Implementation of ISO 14001 standards.
- Environmental best practice technologies for waste minimization.
- Demonstration of advanced waste water treatment practices.
- Efficient membranes use.

MODULE-2

UNIT-1 **12L+8T+4P=24 Hours**

ALTERNATIVE TECHNIQUES TO REDUCE FOOD WASTE:

Use of chlorine for water treatment; Anaerobic digestion of organic residues and wastes; Utilization of plant by products - for the recovery of proteins, dietary fibers, anti-oxidants and their use as nutraceuticals; Anaerobic degradation of animal by- products and utilization of whey. By products of cereals, oilseeds, legumes, dairy, fruits and vegetables, meat, fish, poultry, sugar and confectionery industry.

UNIT-2 **4L+8T+12P=24 Hours**

UTILIZATION OF BY-PRODUCTS OF FOOD INDUSTRIES:

Composting and incineration of food plant waste. Demonstration on Zero discharge system; Demonstration on Zero-emission system; Waste water treatment of brewery, Winery and distillery; Effluent treatment - BOD and COD treatment and disposal of effluents.

SKILLS:

- ✓ *Treatment of waste according to standards.*
- ✓ *Design procedure for waste treatment.*
- ✓ *Design alternative techniques for waste treatment.*
- ✓ *Ability to utilize by product from food industry*

PRACTICES:

- Utilization of by-products of food industries - composting and incineration of food plant waste.
- Demonstration on Zero discharge system;
- Demonstration on Zero-emission system;
- Waste water treatment of brewery, Winery and distillery;
- Effluent treatment - BOD and COD treatment and disposal of effluents.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to :

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the fundamental knowledge to reduce waste creation.	Apply	1	1, 2
2	Analyze types operation in wastewater treatment.	Apply	1	1, 2, 5
3	Create alternative approach to reduce food waste	Apply	1	2,3
4	Investigate efficiency of anaerobic digestion.	Analyze	2	1, 2
5	Design new composite materials from food waste	Analyze	2	1, 2

TEXT BOOKS:

1. V. Oreopoulou and W. Russ, “Utilization of By-Products and Treatment of Waste in the Food Industry”, 3rd Volume, Springer, 2007.
2. K. Waldron, “Handbook of Waste Management and Co-Product Recovery in Food Processing”, 1st Edition, CRC, 2007.

REFERENCE BOOKS:

1. R. Smith, J. Klemes and J. Kim, “Handbook of Water and Energy Management in Food Processing”, 1st Edition, CRC, 2008.