SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

COIMBATORE – 641062

DEPARTMENT OF FOOD TECHNOLOGY

CURRICULUM & SYLLABUS

REGULATIONS - 2019

APPROVED BY BOS CHAIRMAN

VISION AND MISSION OF THE INSTUTITION

VISION:

To make the institution one of our nation's great engineering schools recognized nationally and internationally for excellence in teaching, research and public service. We seek to be the preferred destination for students, practitioners seeking an engineering education, employers hiring engineering graduates and organizations seeking engineering knowledge.

MISSION:

To provide an encouraging environment to develop the intellectual capacity, critical thinking, creativity and problem solving ability of the students.

## VISION AND MISSION OF THE DEPARTMENT

VISION:

1. To facilitate transformation of students to morally sound, professionally outstanding technocrats, entrepreneurs and researchers involved in the improvement of quality and safety by processing and preserving foods.
2. To upgrading the nutritional and economic status of the countrymen by serving the rural community and the general public.

MISSION:

1. To promote quality education, research, innovations and solutions in Food Technology.
2. To develop students as leaders in frontier areas in Food Technology.
3. To enrich Industry and Institute partnership thereby enhance the entrepreneurial skills for upgrading nutritional and economic status of the countrymen by serving the rural community and the general public.

SRI SHAKTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

COIMBATORE – 641062
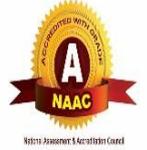
B.TECH. FOOD TECHNOLOGY

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PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1:	To provide students with the basic knowledge skills and use of latest technologies in food science and technology
PEO2:	To provide students an awareness and skills that help in lifelong learning and self-education
PEO3:	To provide students with overall competency and the impact on society and the professional responsibilities as technologist

PROGRAMME OUTCOMES:

Engineering Graduates will be able to:

PO1	a	Engineering Knowledge: Apply the Knowledge of Mathematics science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	b	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusion using first principles of mathematics, natural sciences, and engineering sciences.
PO3	c	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	d	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	e	Modern tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	f	The Engineer and Society: Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	g	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.

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PO8	h	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	i	Individual and team work: Function effectively as a individual, and as a member or leader in diverse teams and the multidisciplinary settings.
PO10	j	Communication: Communicate effectively on the 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	k	Project Management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and multidisciplinary environments
PO12	l	Lifelong Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest contest of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO1	Analyze and formulate ways to process, preserve, package, or store food, according to industrial requirements
PSO2	Ability to apply standard practices and rules in developing the food and allied products.
PSO3	Employ modern technologies to produce new or value-added products in the area of food process engineering/food technology.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	1	1	2	2	1	3	2	2	2	3	3	3
2	2	2	2	1	1	2	1	3	2	1	3	1
3	1	2	2	2	2	1	2	2	2	1	2	2

1.High 2.Medium 3.Low

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAMME SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	1	1	2	2	1	2	2	2	1	1	2	2
2	1	1	2	3	2	2	3	2	2	2	2	2
3	1	2	2	3	1	2	3	3	1	2	1	2

1.High 2.Medium 3.Low

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MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Course Outcomes and Programme Outcomes is given in the following table

Sem	Course Name	A	B	C	D	E	F	G	H	I	J	K	L
I	Communicative English		✓		✓						✓		
	Matrices And Calculus for Food Technology	✓	✓		✓	✓						✓	
	Applied Physics for Food Technology		✓				✓						✓
	Computational thinking and problem solving	✓	✓	✓	✓	✓							✓
	Introduction to Food Processing and Preservation	✓	✓				✓						✓
	Introduction to Food Processing and Preservation Laboratory	✓	✓				✓						✓
	Biology for Food Technologists		✓	✓		✓	✓	✓	✓				✓
	Engineering Exploration – I	✓	✓	✓		✓	✓	✓					✓
	Crop Production Laboratory - I						✓						✓
	Language - Tamil Language – Malayalam										✓		
II	English for Engineers										✓		✓
	English for Engineers Laboratory										✓		✓
	Laplace Transforms and Advanced Calculus for Food Technology	✓	✓	✓	✓	✓							
	Engineering graphics	✓	✓	✓		✓	✓			✓			
	C Programming	✓	✓	✓	✓	✓							✓
	C Programming Laboratory	✓	✓	✓	✓	✓							✓
	Food Chemistry and Nutrition	✓	✓			✓	✓						✓
	Food Chemistry and Nutrition Laboratory	✓	✓			✓	✓						✓
	Unit operations in Food Processing Industries	✓	✓	✓		✓		✓					
	Unit operations in Food Processing Industries Laboratory	✓	✓	✓		✓		✓					
	Engineering Exploration – II	✓	✓	✓		✓	✓	✓					✓

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Sem	Course	1	2	3	4	5	6	7	8	9	10	11	12
III	Applied Thermodynamics	✓	✓	✓		✓							
	Principles of fluid mechanics	✓	✓	✓		✓		✓					
	Engineering Exploration – III	✓	✓	✓		✓	✓	✓					✓
	Dairy Engineering	✓		✓		✓		✓					✓
	Dairy Engineering Laboratory	✓		✓		✓		✓					✓
	Food Biochemistry	✓	✓						✓				✓
	Food Biochemistry Laboratory	✓	✓						✓				✓
	Career Enhancement Program - I									✓	✓		✓
	Probability and Numerical Methods	✓	✓		✓								
	Probability and Numerical Methods Laboratory	✓	✓		✓								
	Basics of Electrical and Electronics Engineering	✓	✓	✓		✓		✓					✓
	Basics of Electrical and Electronics Engineering Laboratory	✓	✓	✓		✓		✓					✓
IV	Statistics	✓	✓	✓	✓	✓				✓	✓	✓	
	Statistics Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	
	Theory of Machines	✓	✓	✓		✓		✓					✓
	Theory of Machines Laboratory	✓	✓	✓		✓		✓					✓
	Post-Harvest Technology of Cereals, Pulses and Oil seeds	✓		✓		✓		✓					✓
	Post-Harvest Technology of Cereals, Pulses and Oil seeds Laboratory	✓		✓		✓		✓					✓
	Food Microbiology	✓	✓		✓	✓		✓	✓				✓
	Food Microbiology Laboratory	✓	✓		✓	✓		✓	✓				✓
	Food Process Calculations	✓	✓	✓	✓	✓							
	Food Analysis	✓	✓	✓	✓	✓	✓		✓				✓
	Food Analysis Laboratory	✓	✓	✓	✓	✓	✓		✓				✓
	Engineering Exploration - IV	✓	✓	✓		✓	✓	✓					✓
	Career Enhancement Program - II									✓	✓		✓
V	Instrumentation and Process Control in Food Industries	✓	✓			✓	✓	✓					
	Fundamentals of Heat and Mass Transfer in Food Technology	✓	✓	✓		✓							
	Food Process Equipment Design	✓	✓	✓	✓	✓							
	Livestock and Fish Processing Technology	✓	✓			✓		✓	✓				✓
	Food Additives		✓				✓		✓				✓
	Professional Elective (PE –I)												
	Open Elective (OE -1)	✓	✓	✓		✓	✓	✓					✓
	Fundamentals of Heat and Mass Transfer in Food Technology Laboratory	✓	✓	✓		✓							
	Food Process Equipment Design Laboratory	✓	✓	✓	✓	✓							
	Livestock and Fish Processing	✓	✓			✓		✓	✓				✓

Sem	Course	1	2	3	4	5	6	7	8	9	10	11	12
	Laboratory												
	Food Additives Laboratory		✓			✓		✓					✓
	Engineering Exploration - V	✓	✓	✓		✓	✓	✓					✓
	Career Enhancement Program - III									✓	✓		✓
VI	Baking and Confectionery Technology	✓	✓			✓		✓	✓				✓
	Fruits and Vegetable Processing Technology	✓	✓			✓		✓	✓				✓
	Refrigeration and Cold Chain Management	✓	✓	✓	✓	✓							✓
	Professional Elective (PE – II)												
	Professional Elective (PE – III)												
	Open Elective (OE –II)	✓	✓	✓		✓	✓	✓					✓
	Baking and Confectionery Technology Laboratory		✓			✓		✓					✓
	Fruits and Vegetable Processing Laboratory		✓			✓		✓					✓
	Career Enhancement Programme – IV									✓	✓		✓
	Mini Project	✓	✓	✓		✓	✓	✓					✓
VII	Food Packaging	✓		✓		✓		✓	✓		✓		✓
	Food Packaging Laboratory	✓		✓		✓		✓	✓		✓		✓
	Food Safety, Quality and Regulations	✓	✓		✓		✓	✓		✓	✓		✓
	Professional Elective (PE – IV)	✓	✓	✓	✓	✓	✓	✓		✓			✓
	Open Elective (OE – III)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Professional Ethics and Engineering	✓	✓		✓		✓	✓		✓	✓		✓
	Professional Elective (PE –V)	✓		✓		✓		✓					✓
	Project Phase – I	✓	✓	✓		✓	✓	✓		✓			✓
VIII	Project Phase – II	✓	✓	✓		✓	✓	✓		✓			✓

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CHOICE BASED CREDIT SYSTEM

I - VIII CURRICULAM AND SYLLABI

SEMESTER I

S.NO	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19ENTL101T	Communicative English	HS	2	2	0	0	2
2	U19MATH108	Matrices And Calculus for Food Technology	BS	4	3	1	0	4
3	U19PHTL104T	Applied Physics for Food Technology	BS	4	2	0	0	2
4	U19CSTL101T	Computational Thinking and Problem Solving	ES	4	3	0	2	3
5	U19FTTL101T	Introduction to Food Processing and Preservation	PC	4	2	0	1	3
6	U19ENTL101L	Communicative English Laboratory	HS	2	0	0	2	1
7	U19PHTL104L	Applied Physics Laboratory for Food Technology	BS	3	0	0	1	1
8	U19CSTL101L	Computational Thinking and Problem Solving Laboratory	ES	3	0	0	1	1
9	U19FTTL101L	Introduction to Food Processing and Preservation Laboratory	PC	3	0	0	1	1
10	U19FTTH103	Biology for Food Technologists	PC	2	1	0	0	1
11	U19CCEX101	Engineering Exploration – I	EEC	4	0	0	2	2
12	U19AEPC101	Crop Production Laboratory – I	BS	4	0	0	4	2
13	U19LATH101 U19LATH102 U19LAEN101	Language - Tamil Language – Malayalam Foundation English	HS	3	2	0	0	2
			Total	39	14	1	13	25

SEMESTER II

S.NO.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19ENTL202T	English for Engineers	HS	2	2	0	0	2
2	U19ENTL202L	English for Engineers Laboratory	HS	2	0	0	2	1
3	U19MATH217	Laplace Transforms and Advanced Calculus for Food Technology	BS	4	3	1	0	4
4	U19METP202	Engineering graphics	ES	3	1	0	2	2
5	U19CSTL203T	C Programming	ES	4	3	0	0	3
6	U19CSTL203L	C Programming Laboratory	ES	3	0	0	2	1
7	U19FTTL202T	Food Chemistry and Nutrition	PC	3	2	0	0	2
8	U19FTTL202L	Food Chemistry and Nutrition Laboratory	PC	2	0	0	2	1
9	U19FTTL203T	Unit operations in Food Processing Industries	PC	4	3	0	0	3
10	U19FTTL203L	Unit operations in Food Processing Industries Laboratory	PC	3	0	0	2	1
11	U19CCEX202	Engineering Exploration – II	EEC	3	1	0	2	2
			Total	36	15	1	12	22

SEMESTER III

S.NO.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19METH301	Applied Thermodynamics	ES	4	2	1	0	3
2	U19CETH306	Principles of fluid mechanics	ES	3	2	0	0	2
3	U19CCEX303	Engineering Exploration – III	EEC	3	0	0	2	1
4	U19FTTL304T	Dairy Engineering	PC	4	2	1	0	3
5	U19FTTL304L	Dairy Engineering Laboratory	PC	3	0	0	2	1
6	U19FTTL305T	Food Biochemistry	PC	4	2	1	0	3
7	U19FTTL305L	Food Biochemistry Laboratory	PC	3	0	0	2	1
8	U19CCLC301	Career Enhancement Program - I	HS	2	0	1	2	1
9	U19MATL302T	Probability and Numerical Methods	BS	3	3	0	0	3
10	U19MATL302L	Probability and Numerical Methods Laboratory	BS	2	0	0	2	1
11	U19EETL301T	Basics of Electrical and Electronics Engineering	ES	4	2	0	0	3
12	U19EETL301L	Basics of Electrical and Electronics Engineering Laboratory	ES	3	0	0	2	1
			Total	41	12	3	14	23

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SEMESTER IV

S.NO.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19MATL404T	Statistics	BS	3	2	0	0	2
2	U19MATL404L	Statistics Laboratory	BS	2	0	0	2	1
3	U19METL403T	Theory of Machines	ES	4	3	0	0	3
4	U19METL403L	Theory of Machines Laboratory	ES	3	0	0	2	1
5	U19FTTL401T	Post-Harvest Technology of Cereals, Pulses and Oil seeds	PC	4	3	0	0	3
6	U19FTTL401L	Post-Harvest Technology of Cereals, Pulses and Oil seeds Laboratory	PC	3	0	0	2	1
7	U19FTTL406T	Food Microbiology	PC	4	3	0	0	3
8	U19FTTL406L	Food Microbiology Laboratory	PC	3	0	0	2	1
9	U19FTTH407	Food Process Calculations	PC	4	3	0	0	3
10	U19FTTL408T	Food Analysis	PC	4	3	0	0	3
11	U19FTTL408L	Food Analysis Laboratory	PC	3	0	0	2	1
12	U19CCEX404	Engineering Exploration – IV	EEC	3	0	0	2	1
13	U19CCLC402	Career Enhancement Program – II	HS	2	0	0	2	1
			Total	44	16	0	16	24

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SEMESTER V

S.No.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19ECTH505	Instrumentation and Process Control in Food Industries	ES	4	3	0	0	3
2	U19FTTL509T	Fundamentals of Heat and Mass Transfer in Food Technology	PC	5	3	1	0	4
3	U19FTTL510T	Food Process Equipment Design	PC	4	3	0	0	3
4	U19FTTL511T	Livestock and Fish Processing Technology	PC	4	3	0	0	3
5	U19FTTL512T	Food Additives	PC	4	3	0	0	3
6		Professional Elective – 1	PE	4	3	0	0	3
7		Open Elective – 1	OE	4	3	1	0	3
8	U19FTTL509L	Fundamentals of Heat and Mass Transfer in Food Technology Laboratory	PC	3	0	0	2	1
9	U19FTTL510L	Food Process Equipment Design Laboratory	PC	3	0	0	2	1
10	U19FTTL511L	Livestock and Fish Processing Laboratory	PC	3	0	0	2	1
11	U19FTTL512L	Food Additives Laboratory	PC	3	0	0	2	1
12	U19CCEX505	Engineering Exploration – V	EEC	3	1	0	2	1
13	U19CCLC503	Career Enhancement Program – III	EEC	2	1	1	0	1
			Total	46	23	2	10	28

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SEMESTER VI

S.No.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19FTTL613T	Baking and Confectionery Technology	PC	4	3	0	2	3
2	U19FTTL614T	Fruits and Vegetable Processing Technology	PC	4	3	0	2	3
3	U19FTTH608	Refrigeration and Cold Chain Management	ES	4	3	0	0	3
4		Professional Elective – II	PE	4	3	0	0	3
5		Professional Elective – III	PE	4	3	0	0	3
6		Open Elective – II	OE	4	3	0	0	3
7	U19FTTL613L	Baking and Confectionery Technology Laboratory	PC	3	0	0	2	1
8	U19FTTL614L	Fruits and Vegetable Processing Laboratory	PG	3	0	0	2	1
9	U19CCLC604	Career Enhancement Programme – IV	EEC	2	1	0	0	1
10	U19FTPR601	Mini Project	EEC	4	0	0	3	2
Total				36	16	0	11	23

SEMESTER VII

S.No.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19FTTH709	Professional Ethics in Engineering	PC	4	3	0	0	3
2	U19FTTH710	Food Packaging	PC	4	4	0	0	3
3	U19FTTH711	Food Safety, Quality and Regulations	PC	4	4	0	0	3
4	U19FTTH712	Functional Foods and Nutraceuticals	PC	4	3	0	0	3
5		Professional Elective – IV	PE	4	3	0	0	3
6		Professional Elective – V	PE	4	3	0	0	3
7	U19FTPR702	Project Phase – I	PC	3	0	0	4	2
			Total	27	20	0	4	20

SEMESTER VIII

S.No.	COURSE CODE	COURSE NAME	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19FTPR803	Project Phase – II	PC	10	0	0	12	6
			Total	10	0	0	12	6

TOTAL NO. OF CREDITS: 171

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HUMANITIES AND SOCIALSCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19ENTL101	Communicative English	HS	4	2	0	2	3
2	U19LATH101 U19LATH102	Language – Tamil Language – Malayalam	HS	3	2	0	0	2
3	U19ENTL202T	English for Engineers	HS	3	2	0	0	2
4	U19ENTL202L	English for Engineers Laboratory	HS	3	0	0	2	1
5	U19CCLC402	Career Enhancement Program - II	HS	3	0	0	2	1

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19MATH108	Matrices and Calculus for Food Technology	BS	5	3	1	0	4
2	U19PHTL104	Applied Physics for Food Technology	BS	4	2	0	2	3
3	U19AEPC101	Crop Production Laboratory-I	BS	4	0	0	4	2
4	U19MATH217	Laplace Transforms and Advanced Calculus for Food Technology	BS	5	3	1	0	4
5	U19MATL302T	Probability and Numerical Methods	BS	4	3	0	0	3
6	U19MATL302L	Probability and Numerical Methods Laboratory	BS	3	0	0	2	1
7	U19MATL404T	Statistics	BS	4	3	0	0	3
8	U19MATL404L	Statistics Laboratory	BS	3	0	0	2	1

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ENGINEERING SCIENCES (ES)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19CSTL101	Computational Thinking and Problem Solving	ES	5	3	0	2	4
2	U19METP202	Engineering Graphics	ES	3	1	0	2	2
3	U19CSTL203T	C Programming	ES	4	3	0	0	3
4	U19CSTL203L	C Programming Laboratory	ES	3	0	0	2	1
5	U19METH301	Applied Thermodynamics	ES	4	2	1	0	3
6	U19CETH306	Principles of Fluid Mechanics	ES	4	2	0	0	3
7	U19EETL301T	Basics of Electrical and Electronics Engineering	ES	4	2	0	0	3
8	U19EETL301L	Basics of Electrical and Electronics Engineering Laboratory	ES	3	0	0	2	1
9	U19METL403T	Theory of Machines	ES	4	3	0	0	3
10	U19METL403L	Theory of Machines Laboratory	ES	3	0	0	2	1
11	U19ECTH505	Instrumentation and Process Control in Food Industries	ES	4	3	0	0	3

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19FTTL101T	Introduction to Food Processing and Preservation	PC	4	2	0	1	3
2	U19FTTL101L	Introduction to Food Processing and Preservation	PC	3	0	0	2	1
3	U19FTTH103	Biology for Food Technologists	PC	2	1	0	0	1
4	U19FTTL202T	Food Chemistry and Nutrition	PC	4	2	0	0	2
5	U19FTTL202L	Food Chemistry and Nutrition Laboratory	PC	3	0	0	2	1
6	U19FTTL203T	Unit Operations in Food Processing Industries	PC	4	3	0	0	3
7	U19FTTL203L	Unit Operations in Food Processing Industries Laboratory	PC	3	0	0	2	1
8	U19FTTL304T	Dairy Engineering	PC	4	2	1	0	3
9	U19FTTL304L	Dairy Engineering Laboratory	PC	3	0	0	2	1
10	U19FTTL305T	Food Biochemistry	PC	4	2	1	0	3
11	U19FTTL305L	Food Biochemistry Laboratory	PC	3	0	0	2	1
12	U19FTTL401T	Post-Harvest Technology of Cereals, Pulses and Oil seeds	PC	4	3	0	0	3
13	U19FTTL401L	Post-Harvest Technology of Cereals, Pulses and Oil seeds Laboratory	PC	3	0	0	2	1
14	U19FTTL406T	Food Microbiology	PC	4	3	0	0	3
15	U19FTTL406L	Food Microbiology Laboratory	PC	3	0	0	2	1
16	U19FTTH407	Food Process Calculations	PC	4	3	0	0	3
17	U19FTTL408T	Food Analysis	PC	4	3	0	0	3
19	U19FTTL408L	Food Analysis Laboratory	PC	3	0	0	2	1
20	U9FTTL510T	Food Process Equipment Design	PC	4	3	0	0	3
21	U19FTTL511T	Livestock and Fish Processing Technology	PC	4	3	0	0	3
23	U19FTTL512T	Food Additives	PC	4	3	0	0	3
24	U19FTTL509T	Fundamentals of Heat and Mass Transfer in Food Technology	PC	4	3	0	0	4
25	U19FTTL509L	Fundamentals of Heat and Mass Transfer in Food Technology Laboratory	PC	3	0	0	2	1
26	U19FTTL510L	Food Process Equipment Design Laboratory	PC	3	0	0	2	1
27	U19FTTL511L	Livestock and Fish Processing Laboratory	PC	3	0	0	2	1
28	U19FTTL512L	Food Additives Laboratory	PC	3	0	0	2	1
29	U19FTTL613T	Baking and Confectionery Technology	PC	4	3	0	2	3
30	U19FTTL614T	Fruits and Vegetable Processing Technology	PC	4	3	0	2	3

31	U19FTTH608	Refrigeration and Cold Chain Management	PC	4	3	0	0	3
32	U19FTTL613L	Baking and Confectionery Technology Laboratory	PC	3	0	0	2	1
33	U19FTTL614L	Fruits and Vegetable Processing Laboratory	PG	3	0	0	2	1
34	U19FTTH710	Food Packaging	PC	4	4	0	0	3
35	U19FTTH711	Food Safety Quality and Regulations	PC	4	4	0	0	3
36	U19FTTH709	Professional Ethics in Engineering	PC	4	3	0	0	3
37	U19FTTH712	Functional Foods and Nutraceuticals	PC	4	3	0	0	3
38	U19FTPR702	Project Phase-I	EEC	6	0	0	4	2
39	U19FTPR803	Project Phase – II	EEC	10	0	0	12	6

APPROVED BY BOS CHAIRMAN

PROFESSIONAL ELECTIVES (PE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19FTPE001	Spices, Plantation and Tuber Crops Technology	PE	4	3	0	0	3
2	U19FTPE002	Fat and oil Processing Technology	PE	4	3	0	0	3
3	U19FTPE003	Economics and Layout Design for Food Technologists	PE	4	3	0	0	3
4	U19FTPE004	Recent Trends in Food Processing	PE	4	3	0	0	3
5	U19FTPE005	Food Nanotechnology	PE	4	3	0	0	3
6	U19FTPE006	Food Extrusion Technology	PE	4	3	0	0	3
7	U19FTPE007	Speciality Foods	PE	4	3	0	0	3
8	U19FTPE008	Engineering Properties of Food Materials	PE	4	3	0	0	3
9	U19FTPE009	Food Material Science	PE	4	3	0	0	3
10	U19FTPE010	Beverage Technology	PE	4	3	0	0	3
11	U19FTPE011	Biology and Chemistry of Food Flavours	PE	4	3	0	0	3
12	U19FTPE012	Creative Innovation and New Product Development	PE	4	3	0	0	3
13	U19FTPE013	Food Green Chemistry and Technology	PE	4	3	0	0	3
14	U19FTPE014	Mechanical Systems for Food Technology	PE	4	3	0	0	3
15	U19FTPE015	Drying Technology	PE	4	3	0	0	3
16	U19FTPE016	Management of Food Waste	PE	4	3	0	0	3
17	U19FTPE017	Functional Foods and Nutraceuticals	PE	4	3	0	0	3
18	U19FTPE018	Total Quality Management	PE	4	3	0	0	3
19	U19FTPE019	Food Processing Enterprise	PE	4	3	0	0	3
20	U19FTPE020	Food Supply Chain Management	PE	4	3	0	0	3

LIST OF OPEN ELECTIVES

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19FTOE001	Nutrition and Dietics	OE	4	3	1	0	3
2	U19FTOE002	Principles of Food Preservation	OE	4	3	0	0	3
3	U19FTOE003	Principle of Food Materials	OE	4	3	1	0	3
4	U19FTOE004	Beverage Technology	OE	4	3	1	0	3

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	U19CCEX101	Engineering Exploration-I	EEC	3	1	0	2	2
2	U19CCEX202	Engineering Exploration-II	EEC	3	1	0	2	2
3	U19CCEX303	Engineering Exploration-III	EEC	3	1	0	2	2
4	U19CCLC301	Career Enhancement Program-I	EEC	2	0	0	2	1
5	U19CCEX404	Engineering Exploration-IV	EEC	3	1	0	2	2
6	U19CCEX505	Engineering Exploration-V	EEC	3	1	0	2	1
7	U19CCLC503	Career Enhancement Program-III	EEC	2	0	0	2	1
8	U19CCLC604	Career Enhancement Program-IV	EEC	2	1	0	0	1
9	U19FTPR601	Mini Project	EEC	4	0	0	3	2

SUMMARY

S.No	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	5	3	-	1	-	-	-	-	9	5.26
2	BS	9	4	4	3	-	-	-	-	20	11.69
3	ES	4	6	9	4	3	-	-	-	26	15.20
4	PC	5	7	8	15	17	11	14	6	83	48.53
5	PE	-	-	-	-	3	6	6	-	15	8.77
6	OE	-	-	-	-	3	3	-	-	6	3.50
7	EEC	2	2	2	1	2	3	-	-	12	7.01
	Total	25	22	23	24	28	23	20	6	171	100

U19ENTL101T	COMMUNICATIVE ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives:

- To develop the basic reading and writing skills of first-year engineering and technology students.
- To help learners develop their listening skills, which will enable them to listen to lectures and comprehend them by asking questions and seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop a vocabulary of a general kind by developing their reading skill
- To enable fluent speaking with appropriate pronunciation.

Course Outcomes:

At the end of the course, learners will be able to

CO1 : Read articles of a general kind in magazines and newspapers.

CO2 : Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.

CO3 : Comprehend conversations and short talks delivered in English

CO4 : Write short essays of a general kind and personal letters and emails in English

CO5: Learned to greet and respond to greetings

CO6: Apply stress and intonation while speaking to make the presentation effective.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										3	3	3		2	
2										2	2	3			2
3										2	3	3		2	
4										2	3	3			2
5										2	2	3		2	
6										3	2	2			

3 - High, 2 - Medium, 1 – Low

UNIT I   Communication Concepts   9

Listening and filling out a form, listening to speeches, and answering questions – Introducing oneself –introducing friends/family, Using Discourse Markers in Speech – Reading passages from newspapers/magazines- Writing a paragraph (native place, school life), Para jumbles - Parts of Speech, Tense Forms – Vocabulary: One-word substitution

UNIT II   Focus On Soft Skills   9

Etiquette - Work Place etiquette - Telephone etiquette - Body Language - Persuasive Communication Speaking - Critical Reasoning - Roleplays- FAQs in Interviews - Writing a checklist - Framing questions, Tag questions -Vocabulary: Compound / Blend Words, Odd Words

UNIT III   Technical Writing   9

Listening to speeches and answering MCQs, Sentence Completion, and Sentence Improvement - Giving short talks on a given topic, Making Polite Requests – Preparing Instructions – Cloze Writing - Articles - Collocations, Odd Words – Interpretation of Technical Data.

UNIT IV   Focus Professional Writing   9

Preparing Resumes, Memos - Giving recommendations – Writing Abstracts and Articles - Phrasal verbs - Reading Comprehension Passages from GRE, IELTS, TOEFL, …

UNIT V   Technical Communication   9

Group Discussions, Presentation with the use of Visual Aids – Product Description – Project Description - Spotting Errors – Writing Definitions - Vocabulary Development: Synonyms / Antonyms, Homonyms/ Homophones.

TOTAL: 45 HOURS

TEXT BOOKS
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES
1. Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2013.
2. Jean Naterop B. and Rod Revel , "Telephoning in English", Cambridge University Press, Cambridge, 2011.
3. David A. Mc Murrey and Joanne Buckley, "Handbook for Technical Writing", Cengage Learning, New Delhi, 2011.
4. Simon Sweeney, "English for Business Communication", Cambridge University Press, New Delhi, 2012.

U19ENTL101L	COMMUNICATIVE ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

List of Lab Components
1. Organs of Speech
2. Pronunciation – Vowels
3. Pronunciation – Diphthongs
4. Pronunciation - Consonants
5. Word Transcription
6. Pronunciation tips
7. Word stress
8. Intonation
9. News/ Video clips
10. Conversation
11. Self-introduction (Video Recording)
12. Ted Talks (comprehension and questions)

Total: 45 HOURS

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U19MATH108   MATRICES AND CALCULUS FOR FOOD TECHNOLOGY   3 1 0 4

Course Objectives:
- Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems.
- It enables precise representation and communication of knowledge.
- The objective of the course is to expose students to understand the basics and importance of Matrix Theory,
- Differential Calculus, Integral Calculus and Ordinary Differential Equations which are being widely used in Food Technology studies.

Course Outcomes:
At the end of the course, learners will be able to

CO1 : Calculate the rank of a matrix, Eigen values, Eigen vectors and solutions of system of linear equations

CO2 : Use the applicability of Cayley - Hamilton theorem to find the inverse of a matrix and Diagonalization of matrix.

CO3 : Gain knowledge to find the radius of curvature and torsion of a curve, which are used for analyzing the output data.

CO4 : Gain knowledge to determine values of definite integrals exactly and apply to regions under and between curves.

CO5: Gain knowledge to solve differential equations arising in Food Technology.

CO6: Gain more knowledge to solve matrices calculations in food technology

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2		2							2	2	2	1
2	3	3	2		2							2	2	2	1
3	3	3	2		2							2	2	2	1
4	3	3	2		2							2	2	2	1
5	3	3	2		2							2	2	2	1
6	3	3	2		2							2	2	2	1

3 - High, 2 - Medium, 1 – Low

UNIT I   Matrices   9

Consistency of linear system of equations – Rouche's theorem – Linear transformations – Vectors – Linear dependence – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (excluding proof) – Applications of Matrices in Food Technology

UNIT II   DIAGONALIZATION OF A REAL SYMMETRIC MATRICES   9

Cayley - Hamilton theorem (excluding proof) – Orthogonal matrix – Diagonalization of matrices – Reduction of Quadratic form to Canonical form by orthogonal transformation – Applications of Diagonalization of a real symmetric matrices in Food Technology.

**UNIT III   DIFFERENTIAL CALCULUS AND ITS GEOMETRICAL   9
                   APPLICATIONS**

Derivatives – Curvature – Radius of curvature in Cartesian and Parametric forms   – Simple problems – Centre of curvature – Circle of curvature – Involutes and Evolutes of Parabola –Applications of Differential Calculus in Food Technology.

UNIT IV   INTEGRAL CALCULUS AND MULTIPLE INTEGRALS   9

Definite and Indefinite integrals – Substitution rule – Integration by parts – Double Integrals – Area enclosed by plane curves – Triple integrals in Cartesian coordinates – Applications of Integrals in Food Technology.

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UNIT V   ORDINARY DIFFERENTIAL EQUATIONS   9

Higher order linear differential equations with constant coefficients – Cauchy's linear equations – Simultaneous first order linear equations with constant coefficients – Applications of   Ordinary Differential Equations in Food Technology.

TOTAL: 45 HOURS

TEXT BOOKS

1. Grewal. B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.
2. James Stewart., "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Unit IV-Sections 5.2,5.4(excluding net change Theorem),5.5 and 7.1]

REFERENCES

1.Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011.
2. Peter V. O. 'Neil., "Advanced Engineering Mathematics", 7th Edition Cengage Learning, India pvt., Ltd, New Delhi. 2011.
3.Veerarajan T., "Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi (2008).
4.Weir.M. D and Joel Hass., " Thomas Calculus", 14th Edition, Pearson India, 2017.

U19PHTL104T   **APPLIED PHYSICS FOR FOOD TECHNOLOGY**

L	T	P	C
2	0	0	2

Course Objectives:
- To understand the phenomena of applied optics
- To obtain the knowledge of various types of crystal structure and conducting materials.
- To enrich the understanding of charge carriers in semiconducting materials and devices.
- To understand the basic concepts of superconducting materials.
- To know the principle of magnetic and dielectric materials
- To educate the concepts of nuclear physics

PRE-REQUISITES

As a prerequisite for this course on Engineering Physics, knowledge in physics like Mechanics, Optics, Waves and basic mathematics is essentially required.

UNIT I   APPLIED OPTICS   9

Laser – the principle of Laser, population inversion – types of lasers – Helium-Neon lasers – Semiconductor laser and its applications. Fibre optics – principle – classification optical fibre- fabrication of optic fibres: vapour deposition, fibre pulling, double crucible – transmission of a light wave through optic fibres - fibre optical communication and sensors – engineering applications

UNIT II   CRYSTAL STRUCTURE AND CONDUCTING MATERIALS   9

Solids – types- crystal – lattice – basis, primitive lattice cell, unit cell, seven crystal system -crystal direction and plane- -miller indices- interplanar spacing- the structure of KCl and NaCl crystals Electronic Materials: Classical free electron theory of metals (Drude Lorentz Theory)-Electrical and Thermal conductivity – Wiedemann Franz Law-Fermi energy and Fermi - Dirac distribution function –Density of states-Thermionic Emission. Energy band in solids

UNIT III   SEMICONDUCTING AND SUPERCONDUCTING MATERIALS   9

Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier Concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N type & P-type semiconductors –Hall effect and applications. Superconducting phenomena, properties of superconductors - Type I and Type II superconductors, BCS theory - High Tc superconductors-applications

UNIT IV   MAGNETIC AND DIELECTRIC PROPERTIES   9

Dielectric constant– Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius- Mosotti equation – dielectric loss – different types of dielectric breakdown-Ferro electricity. Introduction to magnetic materials – Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, magneto-resistance materials-Applications

UNIT V   NUCLEAR STRUCTURE AND MODELS   9

Classification of nuclei - General properties of nucleus – Binding energy – Nuclear forces - models of nuclear structure – The Liquid drop model – The Shell model – The Collective model- nuclear reaction or Q-value-Nuclear Fission- Bohr-Wheeler Theory of Nuclear Fission-The chain reaction-Nuclear Fusion.

Total:45 Hours

Course Outcome:

At the end of the course students should be able to

CO1	Acquire the knowledge of phenomena of laser and fibre optics
CO2	Have a fundamental knowledge of crystal structure and conducting materials
CO3	Have a fundamental knowledge of semiconducting materials
CO4	Have a fundamental knowledge of superconducting materials
CO5	Understand the concept, magnetic and dielectric properties of materials
CO6	Know the theory of nuclear physics

CO/PO MAPPING (S/M/W indicates strength of correlation)   **CO/PSO Mapping**
3-High, 2-Medium, 1-Low

CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3													
CO2	3	3													
CO3	3	3													
CO4	3	3													
CO5	3	3													
CO6	3	3													

TEXT BOOKS

T1   S. J. Gupta, Sanjeev Gupta, *Modern Engineering Physics*, Dhanpatrai Publication, New Delhi, 2015.

T2   V. Rajendran, *Engineering Physics*, Mc Graw Hill Education, tenthprint,2017

T3   Brijlal and Subramaniam, *Properties of Matter*, Educational & university, Agra, 1995

T4   Brijlal& N. Subramaniam, *Heat & Thermodynamics* S. Chand publication, New Delhi, 2012.

T5   R. Murugesan and S. Krithika, *Modern Physics*, S. Chand& Co, New Delhi, 2014.

REFERENCE BOOKS

R1   D. S. Madhur, *Elements of properties of matter* S. Chand and Co, New Delhi, 1992.

R2   V. Rajendran, *Engineering Physics,* Tata McGraw Hill, New Delhi, 2017.

R3   B. K. Pandey, S. Chaturvedi, *Engineering Physics*, Cengage Publication, New Delhi, 2018.

U19PHTL104 L　　　**APPLIED PHYSICS LABORATORY FOR FOOD**　　**L**　**T**　**P**　**C**
　　　　　　　　　　　　　　　　TECHNOLOGY
　　　　　　　　　　　　　　(any 10 experiments)　　　　　　**0**　**0**　**1**　**1**

List of Experiments

1. Determination of rigidity modulus of the material of a wire-Torsional Pendulum
2. Determination of Viscosity of a liquid – Poiseuille's method.
3. Uniform Bending and Determination of Young's Modulus.
4. Determination of thickness of a thin wire –Air Wedge
5. Determination of wavelength of mercury spectrum – spectrometer grating
6. Basic operation of Logic Gates
7. Laser (i) Determination of Wavelength and (ii) Determination of Particles size analysis
8. V-I characterization of PNP and NPN transistors
9. V-I characterization of Solar Cells
10. Energy band gap using p-n junction
11. Determination of thermal conductivity of a bad conductor by Lee's disc method
12. Determination of Velocity of Ultrasonic waves in a given liquid using Ultrasonic Interferometer.

Total: 45 HOURS

U19CSTL101T   COMPUTATIONAL THINKING AND PROBLEM SOLVING

L	T	P	C
3	0	2	3

Course Objectives:

The course aims to provide the students

- The course aims to provide the students,
- To understand the various general steps in problem solving.
- To analyze the efficiency of the algorithms.
- To learn to solve problems using C.
- To understand the concept of arrays and strings.
- To learn C functions and storage classes.

PREREQUISITES :Nil

Course Articulation Matrix : 3- High, 2- Medium, 3- Low														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		3		1								3	3	
CO2	3													2	
CO3		2	3											2	
CO4	3		3		3								3	2	2
CO5	3	2		2					2		2	2	1	2	2
CO6	3	2	3	2					2		2	2	2	3	3

UNIT I   INTRODUCTION TO COMPUTER PROBLEM SOLVING   9

Computers - Introduction, CPU - ALU, Memory – RAM/ROM, Input/Output, hard disk, storage.

The problem solving Aspect, Top-Down Design, Implementation of Algorithms, Program Verification, Introduction, Information and data, Data encoding, number systems. Logic: Boolean logic.

UNIT II   PROBLEM SOLVING TECHNIQUES AND ALGORITHMIC THINKING   9

Problem definition, logical reasoning, problem decomposition, abstraction. Flowchart: Name binding, Selection, Repetition, Modularization. Data Organization: List and Arrays. Simple algorithms, Factoring and recursion techniques.

UNIT III   C PROGRAMMING FUNDAMENTALS   9

Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic, Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions. If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do While and Examples. Continue Break and Goto statements.

UNIT IV   ARRAYS & STRINGS   9

Arrays - Concepts, Using Arrays in C, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear Search. Strings - Concepts, C Strings, String Input/output Functions, Arrays of Strings, String Manipulation Functions.

UNIT V   FUNCTIONS   9

Function Basics, User-defined Functions, Calls, Standard Functions, and Methods of Parameter Passing. Recursion- Recursive Functions. Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

Total: 45 HOURS

Course Outcomes:

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At the end of the course students should be able to

CO1: Understand the fundamental concepts of computer and operating systems

CO2: Understand and apply number system conversions

CO3: Create the algorithm and flow charts for a given problem

CO4: Understand the basics of C programming , choose the right data representation formats

CO5: Design and implement applications in C using arrays and strings

CO6: Develop and implement application applications in C using functions

TEXT BOOKS:

1 David Riley and Kenny Hunt, "Computational Thinking for Modern Solver", Chapman & Hall/CRC 2014

2 R.G.Dromey, "How to Solve it by Computer", PHI, 2008

REFERENCE BOOKS:

1 Seyed H Roosta,"Foundations of programming languages design & implementation", Cengage Learning. 2009.

2 Karl Beecher, "Computational Thinking: A beginner's guide to problem-solving and programming", BCS, The Chartered Institute for IT; 1 edition, 2017.

3 Wladston Ferreira Filho, "Computer Science Distilled: Learn the Art of Solving Computational Problems", Code Energy LLC, 2017.

U19CSTL101L	COMPUTATIONAL THINKING AND PROBLEM SOLVING LABORATORY	L	T	P	C
		0	0	1	1

List of Experiments:

1. Design an Algorithm, Flow chart for various problems.
2. Simple Statements and Expressions.
3. Design various algorithms for recursive problems.
4. Design a solution for pattern problems.
5. Create solutions using arrays.
6. Demonstrate various searching techniques.
7. Demonstrate various sorting techniques.
8. Compare and contrast various sorting

Total : 45 HOURS

U19FTTL101T	INTRODUCTION TO FOOD PROCESSING	L	T	P	C

Course Objective:

•To introduce the students to the area of Food Processing and preservation.

•To have an effective understanding of food processing and technology subjects.

•To enable students to appreciate the importance of food processing with respect to the large scale production.

•To import knowledge on processing of food waste

•To acquire basics knowledge on food safety and food hygiene

*To understand the processing methods and its importance of food preservation techniques

PREREQUISITES :Nil

Course Articulation Matrix : 3- High, 2- Medium, 3- Low														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			3	3						3	3	1	3
CO2	3	2			3		3					3	2		3
CO3	3		3		3	2	3		3			3	3		3
CO4	2	3			2	3						2	3	2	1
CO5		2			2	1	2		3	2	2	2	3	1	2
CO6	2		3	2	1		1		1		1	2	1	3	

UNIT I   PROCESSING OF FOOD AND ITS IMPORTANCE   9

Source of food - need and significance of processing foods - food of plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, fats &oil seeds, sugars, tea, coffee, cocoa, spices and condiments, additives.

UNIT II   METHODS OF FOOD HANDLING AND STORAGE   9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III   LARGE-SCALE FOOD PROCESSING   9

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc.; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV   FOOD WASTES   9

Types of Food wastes - Waste disposal-solid and liquid waste - Effluents and their treatment – ETP, storage losses – rodent, insects and pests; pest control measures - use of pesticides

UNIT V   FOOD HYGIENE   9

Food safety - Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food, Personnel hygiene, Training & Education for safe methods of handling and processing food, sterilization and disinfection of manufacturing plant, use of sanitizers, detergents, heat, chemicals, cleaning of equipment and premises

TOTAL: 45 HOURS

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Course Outcomes:

At the end of the course, learners will be able to:

CO1: Understand the basic concepts in the area of Food Processing and preservation.

CO2: Acquire knowledge on food processing methods

CO3: Able to understand the importance of food processing with respect to the large scale production.

CO4: Gain knowledge on processing of food waste

CO5: Have a basic knowledge on food hygiene and food safety

CO6: Analyse the various food processing techniques and its byproducts

TEXT BOOKS

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.

REFERENCES

1. Van Garde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice". Surbhi Publications, 2001.
2. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

U19FTL101L	INTRODUCTION TO FOOD PROCESSING AND PRESERVATION LABORATORY	L	T	P	C
		0	0	1	1

List of Experiments

1. Determination of cooking properties of parboiled rice and raw rice
2. Experiment on determination of food adulteration
3. Determination of properties of milk
4. Experiment on osmotic dehydration of food with salts and sugar
5. Preparation of chikki
6. Preparation of paneer
7. Preparation of sauce and ketchup
8. Preparation of ready-to-serve beverage
9. Preparation of traditional dairy products from thermally coagulated milk (Kalakand)
10. Preparation of mixed fruits jam
11. Experiment on cream separation to determine the separation efficiency
12. Experiment on construction and cooking of butter churner and its accessories

Total : 45 HOURS

APPROVED BY BOS CHAIRMAN

			L	T	P	C
U19FTTH103	**BIOLOGY FOR FOOD TECHNOLOGISTS**		1	0	0	1

Course Objective:

- To familiarize the students with the basic organization of organisms and subsequent building to a living being
- To impart an understanding about the machinery of the cell functions that is ultimately responsible for various daily activities.
- To understand the basic theory of genetics and immune system
- To impart knowledge on various human disease and its treatment methods
- To provide knowledge about biological problems that require engineering expertise to solve them
- To understand the basic classification and importance of microbes.

PREREQUISITES :Nil

Course Articulation Matrix : 3- High, 2- Medium, 3- Low														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										3	3		3
CO2	3	2										3	2		3
CO3	3		3									3	3		3
CO4	2	3										2	3		1
CO5		2										2	3		2
CO6	2		3								1	2	1		

UNIT I   INTRODUCTION TO LIFE   9

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell

UNIT II   BIODIVERSITY   9

Plant System: basic concepts of plant growth – nutrition-photosynthesis and nitrogen fixation. Animal System: elementary study of digestive and excretory systems and their functions. Microbial System: types of microbes-economic importance and control of microbes.

UNIT III   GENETICS AND IMMUNE SYSTEM   9

Nucleic acids as a genetic material-central dogma. Immunity –antigens – antibody-immune response.

UNIT IV   HUMAN DISEASES   9

Definition - causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, influenza, AIDS and Hepatitis

UNIT V   BIOLOGY AND ITS INDUSTRIAL APPLICATION   9

Plant and animal tissue – bioremediation – biofertilizer – biocontrol - biofilters – biosensors – biopolymers – bioenergy – biomaterials-biochips- basic biomedical instrumentation.

TOTAL:45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1 : Familiarize the students with the basic organization of organisms and subsequent building to a living being

CO2 : Impart an understanding about the machinery of the cell functions that is ultimately responsible for various daily activities.

CO3 : Understand the basic theory of genetics and immune system

CO4 : Gain exposure on bioactive components and its application in food industries.

CO5 : Understand the metabolism and absorption of nutrients

CO6 : Analyse and to characterize the importance of microbes involved in food processing sector

TEXT BOOKS

1. Srinivasan Damodaran, Kirk L. Parkin, Fennema's Food Chemistry, CRC Press, 2017.
2. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Narosa, 2010.
3. Meyer, Lillian Hoagland. "Food Chemistry". CBS Publishers, 1987.
4. Deman, John M. "Principles of Food Chemistry". 3rd Edition. Springer, 1999.
5. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". II Edition, KluwerAcademic, Springer, 2003.
6. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
7. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell, 2009.

REFERENCE BOOKS

1. Vickie A. Vaclavik, Elizabeth W. Christain, Essentials of Food Science, Springer, 2013.

2. John M. deMan, John W. Finley, W. Jeffrey Hurst, Chang Yong Lee, Principles of Food Chemistry, Springer, 2018.

3.Gropper, Sareen S. and Jack L.Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

APPROVED BY BOS CHAIRMAN

Course Objectives:

- To introduce the students to principles of field crops production and to introduce the production practices of crops.
- To delineate the role of agricultural and irrigation engineers in relation to various crop production practices.
- To equip the students with necessary theoretical and practical knowhow on basic principles of cropping and acquaint them with the cultivation practice of few important crops of Tamil Nadu..

Course Outcomes:

At the end of the course, learners will be able to

CO1 : Knowledge on crop selection, production and management.

CO2 : Able to understand the importance of crop water management

C03 :Understand the cultivation practices for some of the important crops in Tamil Nadu

C04: Good knowledge in the fileld preparation of crops including systems of tillage

C05: Sound understanding of the production practices of vegetable crops

C06: Students will gain good knowledge in the production of agricultural and horticultural crops

Course Articulation Matrix

CO No	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PSO 3
1	3	3				2								2	2	
2	3	3		2		2	2							2	2	
3	3	3		2	2	2	1							2	2	
4	3	3		1	2	2	2							2	2	
5	3	3				2	2							2	2	
6	3	3		2		2								2	2	

3 - High, 2 - Medium, 1 – Low

List of Components

- To introduce the different crop production practices in wet land, dry land and garden land through hands on experience and demonstrations.
- Identification of different crops in local region
- Visit to meteorological observatory
- Visit to wetlands and irrigate dry lands to learn important cropping systems and Hi Tec nursery
- Seed selection and seed treatment procedures
- Seed bed and nursery preparation
- Sowing / Transplanting
- Biometric observation for crops
- Nutrient management studies
- Water management and irrigation scheduling
- Weed management studies
- Integrated Pest Management studies
- Harvesting
- Post harvesting

TOTAL: 45 HOURS

APPROVED BY BOS CHAIRMAN

TEXT BOOKS

1.Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and
Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.

Hand Book of Agriculture. 2009 (6th revised edition), Indian Council of Agricultural Resarch (ICAR),
New Delhi

2.Balasubramanian P and Palaniappan SP. 2001. Principles and practices of Agronomy. Agrobios
Publishers, Ludhiana

REFERENCES

1.Ramasamy S and Siddeswran K 2018. Agriculture and crop production. Sri Shakthi Institute of
Engineering and Technology, Coimbatore Crop Production Guide, Tamil Nadu Agricultural University
Publication, Coimbatore. 2005

APPROVED BY BOS CHAIRMAN

		L	T	P	C
U19CCEX101	**ENGINEERING EXPLORATION I**	0	0	2	2

Course Objectives:
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

PRE-REQUISITES

NIL

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

Course Outcomes:

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix: 3 – HIGH; 2 –MEDIUM; 1 -LOW

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

	Malayalam	**L**	**T**	**P**	**C**
U19LAML101	(Common to all Programs)	2	0	0	2

Course Objectives:

- To write analytically in a variety of formats, including essays, research papers, reflective writing, and critical reviews of secondary sources.
- To develop an interest in the Mother tongue through the study of literature and other contemporary forms of culture.
- To be proficient in speaking and listening and assist students in the development of intellectual flexibility, creativity, and cultural literacy so that they may engage in life-long learning
- To enhance reading and writing skills for a better understanding of the main contextual ideas
- To use their mother tongue in the formal setup to express their views and ideas using the appropriate vocabulary and phrases.

PRE-REQUISITES

- Nil

UNIT I   Grammar and Language Development   9

Writing- letters, swaraksharangal, vyanjanaksharangal, Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation.

UNIT II   Letter Writing   9

Letter writing: Formal (applications, letter to the editor of a Newspaper, commercial correspondence, complaints) and informal letters.

UNIT III   Reading Comprehension   9

Reading section: Comprehension of unseen prose passages and Short stories

UNIT IV   Extended Speaking   9

Expansion of ideas: Proverbs, poems, and philosophical statements.

UNIT V   Introduction to Malayalam Literature   9

Critical appreciation of literary works (Books and Films). Literary & Cultural figures of Kerala and their literary contributions.

Total: 45 Hours

Course Outcomes:

At the end of the course, students should be able to

CO1 :	Students should be familiar with literary and cultural texts within a significant number of historical, geographical, and cultural contexts.
CO2 :	Students should be able to apply critical and theoretical approaches to the reading and analysis of literary and cultural texts in multiple genres.
CO3 :	Students should be able to ethically gather, understand, evaluate, and synthesize Information from a variety of written and electronic sources from different genres.
CO4 :	Students should be able to write analytically in a variety of formats, including essays, research papers, reflective writing, and critical reviews of secondary sources.
CO5 :	Students should be able to understand the process of communicating and interpreting human experiences through literary representation using historical contexts and disciplinary methodologies.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO/PO MAPPING (3- HIGH; 2 –MEDIUM; 1- LOW)													**CO/PSO Mapping**		
Cos	**PROGRAMME OUTCOMES (POs)**												**PSOs**		
CO1							3	1	2	3		2			2
CO2								2		3		2			2
CO3							3		3	3		2			3
CO4							1		2	3		3			3
CO5								1	3	3		3			3

TEXT BOOKS

1. John D Kunnathu, Lissy J Kunnathu, Learn Basic Malayalam In Six Weeks: With Daily Worksheets & Answer Key; CreateSpace Independent Publishing Platform (June 22, 2015)

2. Vidvan C. L. Meenakshi Amma. Learn Malayalam, manuals_contributions; manuals; additional_collections, 1975

3. Learn Basic Malayalam in Six Weeks: With Daily Worksheets & Answer Key, by John D. Kunnathu (Author), Lissy J. Kunnathu (Author), Kindle Edition

4. A Grammar of the Malayalam Language by Rev H.Gundert, Basel Mission Press, 2002

5. Malayalam Grammar Book Paperback, Kindle Edition, 2018

REFERENCE BOOKS

1. Malayalam: A University Course and Reference Grammar. - Fourth Edition, The Center for Asian Studies at The University of Texas at Austin, 2018

2. An Intensive Course in Malayalam (An Old and Rare Book) by B.Shyamala Kumari, Central Institute of Indian Languages, Mysore, 1999

WEB RESOURCES

1. https://e-resources.saraswatihouse.com
2. https://www.alllanguageresources.com/malayalam/

3. Learning Malayalam: A Complete Self-Study Guide -
   https://www.alllanguageresources.com › Malayalam

U19LATH101 **LANGUAGE - TAMIL**

	L	T	P	C
	2	0	0	2

Course Objectives:

The students should be made

- To enhance listening skill of the learners and practicing it for a better professional as well as moral skills
- To read different text without barriers using reading strategies

Course Articulation Matrix: 3 – HIGH; 2 –MEDIUM; 1 -LOW

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									3	3	2	2	1	
CO2									3	3	2	2	1	
CO3									3	3	2	1	1	
CO4									3		2	1	1	
CO5									3	3	2	3	1	
CO6									3	3	2	2	1	

UNIT- I   **அலகு 1**   **5**

சங்ககாலம்- மூன்றுசங்கங்கள்- முதற்சங்கம் (கடல்கொண்டதென்மதுரை)- இடைச்சங்கம் (கபாடபுரம்)-கடைச்சங்கம்(மதுரை)-சங்க இலக்கியங்கள்- பதினென்மேற்க்கணக்கு நூல்கள்: எட்டுத்தொகைநூல்கள் (ஐங்குறுநூறு, குறுந்தொகை,கலித்தொகை, நற்றிணை, அகநானூறு, புறநானூறு, பதிற்றுப்பத்து, பரிபாடல்)- பத்துப்பாட்டு நூல்கள் (சிறுபாணாற்றுப்படை, பெரும்பாணாற்றுப்படை, திருமுருகாற்றுப்படை, பொருநராற்றுப்படை, மலைபடுகடாம், குறிஞ்சிப்பாட்டு, முல்லைப்பாட்டு, பட்டினப்பாலை, நெடுநல்வாடை, மதுரைக்காஞ்சி.)- சங்கம்மருவியகாலம்- பதினெண்கீ ழ்க்கணக்கு நூல்கள் (திருக்குறள், நாலடியார், நான்மணிக்கடிகை, இன்னாநாற்பது, இனியவைநாற்பது, திரிகடுகம், ஆசாரக்கோவை, பழமொழி, சிறுபஞ்சமூலம், முதுமொழிக்காஞ்சி, ஏலாதி, கார்நாற்பது, களவழிநாற்பது, ஐந்திணைஜம்பது, திணைமொழிஜம்பது, ஐந்திணைஎழுபது, திணைமாலை நூற்றைம்பது, கைந்நிலை)- காப்பியங்கள்- ஐம்பெருங்காப்பியங்கள்- (சிலப்பதிகாரம், மணிமேகலை, சீவகசிந்தாமணி, வளையாபதி, குண்டலகேசி)- ஐஞ்சிறுகாப்பியங்கள் (நாககுமாரகாவியம், உதயணகுமாரகாவியம், யசோதரகாவியம், சூளாமணி, நீலகேசி)- இலக்கணம் - எழுத்து, சொல், பொருள், யாப்பு, அணி - தமிழ் எழுத்துக்கள்- உயிரெழுத்துக்கள், மெய்யெழுத்துக்கள், உயிர்மெய் எழுத்துக்கள், ஆய்தஎழுத்து- வகைகள்- குறில், நெடில், வல்லினம், மெல்லினம், இடையினம், குற்றியலுகரம், குற்றியலிகரம்.

UNIT -II   **அலகு 2**   **5**

மயங்கொலிப்பிழைகள் - ர, ற-ஒலிவேறுபாடுகள-ல, எ, ழஒலிவேறுபாடுகள்-ந, ன, ண-ஒலி வேறுபாடுகள்- சொல் இலக்கணம்- திணை, பால், எண், இடம், காலம் -பேச்சுவழக்கு– எழுத்துவழக்கு- இழிவழக்குச்சொற்கள்-வழுவுச்சொற்கள் - இணைச்சொற்கள்-   தொகைச்சொற்கள்-நிறுத்தற்குறியீடுகள்-

உவமைத்தொடர்கள்- மரபுத்தொடர்கள்- வாக்கியத்தில் அமைத்தல்-மரபுப்பிழை திருத்தம் -ஐந்திணை- பலபொருள்ஒருசொல்- ஒருசொல்பலபொருள்

UNIT- III   **அலகு – 3**   **5**

அணி இலக்கணம் – இயல்புநவிற்சி அணி, உயர்வுநவிற்சி அணி, உவமை அணி- எடுத்துக்காட்டுஉவமை அணி, உருவக அணி, ஏகதேச உருவக அணி, சொற்பொருள் பின்வருநிலைஅணி, தற்குறிப்பேற்ற அணி, வேற்றுமை அணி, வஞ்சப்புகழ்ச்சி அணி, மடக்கணி. பொருந்திய சரியான சொல்லைத் தேர்ந்தெடுத்தல் செய்யுள் பொருளுணர்திறன்.

UNIT - IV   **அலகு – 4**   **5**

திருக்குறள்- 50 குறள்கள்- ஆத்திச்சூடி- கவிதைகள்- பாரதியார் (மனதில் உறுதி வேண்டும்)- பாரதிதாசன் (கனியிடை ஏறியசுளையும்)- வைரமுத்து (ஆதலால்மனிதா…) பெய்யெனப் பெய்யும் மழை கவிதைத்தொகுப்பு-காசி ஆனந்தன் (மாடியிலிருந்து…)-நறுக்குகள் கவிதைத் தொகுப்பு- பழமொழிகள்- விடுகதைகள்

UNIT- V   **அலகு – 5**   **5**

சிறுகதைகள் – ஜெயமோகன், ஜெயகாந்தன், கி.ராஜநாராயணன், பிரபஞ்சன் நீதிக்கதைகள், மொழிபெயர்ப்பு- மூன்றில் ஒருபங்காகச் சுருக்குதல் வினாவிற்கேற்ற விடைகள்- கடிதங்கள்-தலைவர்கள் மற்றும் அறிஞர்கள் பற்றிய கட்டுரைகள்

UNIT- VI   **அலகு – 6**   **5**

படைப்பாற்றல்பயிற்சி – பேச்சுப்பயிற்சி (கதைசொல்லுதல், விவாதித்தல், கவியரங்கம், பட்டிமன்றம்)-எழுத்துப்பயிற்சி (கவிதை, கட்டுரை, சிறுகதை, கடிதங்கள்)

                                                       TOTAL: 30 HOURS

Course Outcomes:
At the end of the course, learners will be able to:
CO1 Learn the language literature concepts
CO2 Speak fluently using the proper vocabulary.
CO3 Familiarize the functional understanding of the language grammar
CO4 Understand the concepts of new era tamil literature works
CO5: To develop the reading skills of tamil novels and stories
CO6: To enhance the features of storytelling, conversation and creative skills of writing in students

	Foundation English	**L**	**T**	**P**	**C**
U19LAEN101	(Common to all Programs)	3	0	0	2

Course Objectives:

- Educate students in both the artistry and utility of the English language through the study of literature and other contemporary forms of culture.
- Provide students with the critical faculties necessary in an academic environment, on the job, and in an increasingly complex, interdependent world.
- Graduate students who are capable of performing research, analysis, and developing content from different genres.
- Assist students in the development of intellectual flexibility, creativity, and cultural literacy so that they may engage in life-long learning.
- Write analytically in a variety of formats, including essays, research papers, reflective writing, and critical reviews of secondary sources.

PRE-REQUISITES

- Nil

UNIT I	**Introduction to English Literature**	**6**

Introduction to the English Language – Introduction to Indian writing in English - Palanquin Bearers by Sarojini Naidu – To me, fair friend, you never can be old, Sonnet 104 by Shakespeare

UNIT II	**Appreciation of Poems**	**6**

Ode on a Grecian Urn by John Keats – Gitanjali by Rabindranath Tagore

UNIT III	**Focus on Short Stories**	**6**

Short Stories: A Christmas Carol by Charles Dickens - The Open Window by Saki - The Interpreter of Maladies by Jhumpa Lahiri – Success Stories of inspirational leaders: Martin Luther King, Malala Yousafzai & Saalumarada Thimmakka, also known as Aalada Marada Timakka, an Indian environmentalist.

UNIT IV	**Focus on Novel**	**6**

Novel: The Man-Eater of Malgudi by R.K.Narayan

UNIT V	**Focus on Drama**	**6**

A Doll's House by Norwegian playwright Henrik Ibsen

Total: 30 Hours

Course Outcomes:

At the end of the course, students should be able to

CO1 : Students should be familiar with literary and cultural texts within a significant number of historical, geographical, and cultural contexts.

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CO2 : Students should be able to apply critical and theoretical approaches to the reading and analysis of literary and cultural texts in multiple genres.

CO3 : Students should be able to ethically gather, understand, evaluate, and synthesize Information from a variety of written and electronic sources from different genres.

CO4 : Students should be able to write analytically in a variety of formats, including essays, research papers, reflective writing, and critical reviews of secondary sources.

CO5 : Students should be able to understand the process of communicating and interpreting human experiences through literary representation using historical contexts and disciplinary methodologies.

Cos	CO/PO MAPPING												CO/PSO Mapping			
	PROGRAMME OUTCOMES (POs)												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1							3	1	2	3		2			2	
CO2								2		3		2			2	
CO3							3		3	3		2			3	
CO4							1		2	3		3			3	
CO5								1	3	3		3			3	

3- HIGH; 2 –MEDIUM; 1 - LOW

Textbooks:
1. Palanquin Bearers Paperback by Sarojini Naidu (Author), Indu Harikumar (Illustrator)
2. Sonnet 104: To Me, Fair Friend, You Never Can Be Old Emma Abbate & Ashley Riches From the Album Mario Castelnuovo-Tedesco: Shakespeare Sonnets
3. Ode On A Grecian Urn And Other Poems (English, Paperback, Keats John), Publisher: Kessinger Publishing Co, Genre: Poetry, ISBN: 9781419137730
4. Gitanjali by Rabindranath Tagore, Kindle edition
5. The Man-eater of Malgudi by R.K. Narayan (Author), Repro Books
6. A Doll's House by Henrik Ibsen, Maple Press, Genre: Fiction, ISBN: 9789350330685

Reference Books:
1. The Open Window and Other Short Stories, Kindle Edition
2. Charles Dickens' Christmas Stories: A Classic Collection, 2019, Kindle Edition

Web Resources:
1. https://www.deccanchronicle.com/lifestyle/books-and-art/220418/saalumarada-thimmakka-the-green-legend-now-on-stage.html
2. https://malala.org/malalas-story
3. https://www.nobelprize.org/prizes/peace/1964/king/biographical/

SEMESTER – II

U19ENTL202T	ENGLISH FOR ENGINEERS	L	T	P	C
	(Common to all Programmes)	2	0	0	2

Course Objectives:

- To develop learners' ability to listen and comprehend talks for the application of language in various context.
- To develop the students' ability to use English accurately, appropriately and fluently in different social and professional situations.
- To comprehend advanced technical passages and to identify the author's purpose and tone.
- To enhance advanced level of writing by organizing ideas and achieving consistency in academic as well as workplace contexts.
- To enhance the technical components of English language for formulating effective and appropriate sentences.

PREREQUISITES
- Nil

THEORY COMPONENT CONTENTS

UNIT I   BASICS OF GRAMMAR   9

Use of the Gerund - Use of the infinite -'Used to' for habitual actions - Degrees of Comparison – Reading Comprehension passage and answering- Essay writing ((Narrative / Descriptive / Expository / Persuasive)- Letter Writing (Suggestions / Apology/ Acceptance).

UNIT II   FOCUS ON LANGUAGE DEVELOPMENT   9

Modal verbs (Possibility, ability, Permission, Suggestions and obligations obligation) - Simple Past vs Present Perfect - Subject and verb agreement - Interpreting charts / Graphs / Tables – Instructions.

UNIT III   FUNCTIONAL GRAMMAR AND FORMAL WRITING   9

Relative Pronouns for people and things - Future with 'be going to' and 'will' - Personal and impersonal passive - Email writing - Memo writing - Expansion of a Proverb.

UNIT IV   EXTENDED WRITING   9

Fixed and Semi-fixed expressions - Wishes and hypotheses - Conditional clauses -Process Description- Notice / Agenda / Minutes of Meeting.

UNIT V   TECHNICAL COMMUNICATION   9

Idioms: guessing meaning based on the context - Question Tags - Reported speech - Technical Proposal – Report Writing (Project / Survey).

Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to

CO1 Communicate with one or many listeners using appropriate communicative strategies.

CO2 Speak clearly, confidently and comprehensively using appropriate communicative strategies.

CO3 Read different genres of texts adopting various reading strategies.

CO4 Understand the form and function of the basic official correspondences and perform a range official support through formal and informal writings.

CO5 Comprehend and apply the language learning strategies to read, comprehend, organize and retain written information.

CO s	CO/PO MAPPING												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1	2	1	1	3		2		2	
CO2						2	2	2	2	3		2		2	
CO3						3	3	1	2	3		3		2	
CO4						1	1		1	3		1		3	

CO5					3	3	3	3	3		3		3	

3-HIGH; 2 –MEDIUM; 1 – LOW

TEXT BOOKS

T1.   Richards, C. Jack. Interchange Students Book-2 New Delhi: CUP, 2015.

T2.   Means,L. Thomas and Elaine Langlois. English and Communication For Colleges. Cengage Learning, USA: 2007.

REFERENCE BOOKS

R1.   Redston, Chris & Gillies Cunningham. Face2Face (Upper-intermediate Student's Book). Cambridge University Press, New Delhi: 2005.

R2.   Daise, Debra &Charl Norloff. Q:Skills for Success Reading and Writing (2nd Edition). Oxford University Press. 2019.

R3.   Sudharshana N Pand Savitha C. English for Technical Communication. Cambridge University Press. 2018.

WEB RESOURCES

W1.   https://learnenglish.britishcouncil.org/grammar

W2.   https://www.kau.edu.sa/Files/0013287/Subjects/academic-writing-handbook-international-students-3rd-ed%20(2).pdf

W3.   https://owl.purdue.edu/owl/general_writing/academic_writing/essay_writing/descriptive_essays.html

U19ENTL202L	**ENGLISH FOR ENGINEERS LABORATORY**	**L**	**T**	**P**	**C**
	(Common for all branches)	**0**	**0**	**2**	**1**

LAB COMPONENT CONTENTS

1.   Telephone conversation

2.   One Minute Talk (Prepared)

3.   Describing a holiday / festivals / special events

4.   BBC Hard Talk / NDTV Big Fight

5.   Impromptu Speech

6.   Story writing

7.   Story telling

8.   Open ended stories

9.   Peacha Kucha

10.   Book Review

11.   Blog writing

12.   TED Talk Presentation

Total: 45 HOURS

U19MATH217   LAPLACE TRANSFORMS AND ADVANCED CALCULUS
                     FOR FOOD TECHNOLOGY   L T P C

Course Objectives:

Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems. It enables precise representation and communication of knowledge. The objective of the course is to expose students to understand the basics and importance of Laplace Transforms, Differential Calculus of several variables, Vector Calculus, Complex Differentiation and Complex Integration which are being widely used in Food Technology studies.

PRE-REQUISITES:

- Basic concepts of differentiation
- Basic concepts of integration
- Basic concepts of vectors and Trigonometric functions

UNIT I – LAPLACE TRANSFORMS   9

Definition– Transforms of Elementary functions – Properties of Laplace transforms (Statement only) – Transforms of Periodic functions – Transforms of derivatives and integrals (Statement only) – Inverse transforms – Convolution theorem (problems only) – Application to linear ODE of second order with constant coefficients

– Applications of Laplace transforms in Food Technology.

UNIT II – VECTOR DIFFERENTIATION   9

Scalar and Vector Point functions – Gradient – Directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Del applied twice to Point functions (Problems only) – Applications of Vector Differentiation in Food Technology.

UNIT III – VECTOR INTEGRATION   9

Line integral – Green's theorem in the plane (excluding proof) – Stoke's theorem (excluding proof) – Gauss divergence theorem (excluding proof) – Simple applications involving cubes and rectangular parallelepipeds– Applications of Vector Integration in Food Technology.

UNIT IV – COMPLEX DIFFERENTIATION   9

Limit and derivative of a complex function -Analytic functions – Cauchy-Riemann equations – Harmonic functions – Orthogonal properties of analytic functions (excluding proof) – Construction of analytic functions by Milne - Thomson's Method – Conformal transformation : $w = z + c$, cz, $1/z$ and Bilinear transformation – Applications of complex differentiation in Food Technology.

UNIT V– COMPLEX INTEGRATION   9

Complex integration – Statements of Cauchy's theorem and Cauchy's integral formula – Laurent's series – Singular points – Residues – Calculation of Residues– Cauchy's Residue theorem (excluding proof) – Applications of complex integration in Food Technology.

Total : 45HOURS

Course Outcomes:

At the end of the course, a student will be able to

CO1   Apply the knowledge of Laplace transforms to solve the differential and integral equations.

CO2   Perform vector calculus operations such as gradient, divergence and curl in vector and scalar fields.

CO3   Apply the techniques of line, surface and volume integrals to solve application Problems.

CO4   Gain knowledge to construct the analytic function and to find the image of given region under conformal mapping.

CO5   Gain knowledge to solve the problems by using complex integration

CO/PO MAPPING(S/M/W indicates strength of correlation)	CO/PSO

	3-HIGH, 2-MEDIUM,1-LOW												Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2							2	2	2	1
CO2	3	3	2		2							2	2	2	1
CO3	3	3	2		2							2	2	2	1
CO4	3	3	2		2							2	2	2	1
CO5	3	3	2		2							2	2	2	1

TEXT BOOKS:

T1. Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.

REFERENCE BOOKS:

R1. Bali. N. P and Manish Goyal., "A Text book of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt., Ltd., 2010.

R2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education - 2011.

R3. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011.

R4. Peter V. O 'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.

. R5. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

U19METP202	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
		1	0	0	2

APPROVED BY BOS CHAIRMAN

Course Objectives:
- ❖ To develop the students in Engineering Drawing concepts for communication, better ideas to design and develop engineering products.
- ❖ To develop the skill of expressing three-dimensional and two-dimensional objects into professional language and vice versa.
- ❖ To develop clear understanding of plane and solid geometry so as to apply the same in relevant practical fields such as technology and industry.
- ❖ To provide knowledge in BIS applicable to technical drawings.
- ❖ To expose them knowledge in basics of computer aided design, graphics and AutoCAD software.

Course Outcomes:

At the end of the course, learners will be able to

C01: Familiarize with the fundamentals and standards of engineering drawing.

C02: Project orthographic projections of Points, Lines, Plane Surfaces and Solids

C03: Draw Development of Surfaces and Visualize and to project isometric sections of simple solids Getting acquainted with AutoCAD

C04: Create Technical Documentations/Presentations of models from Mechanical Engineering Discipline in both technically and visually pleasing formats

C05: Apply the concept of drawing in practical applications.

C06: Draw isometric projection and perspective views of an object/solid

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2									2					2
2	1									1				1	1
3	3									3					3
4	3									3					3
5	1									1					1
6	3		1							3					3

3 - High, 2 - Medium, 1 – Low

PRE-REQUISITES

As a prerequisite for this course on Engineering Graphics, knowledge of Geometry, Visualizing objects, Basic use of computer are essentially required.

THEORY COMPONENT CONTENTS

UNIT I   PLAIN CURVES AND FREEHAND SKETCHING   9

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Conics Sections – Construction of ellipse, parabola and hyperbola by eccentricity method – Cycloid –Involutes of square and circle– Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II   PROJECTION OF POINTS, LINES, PLANES AND SOLIDS   9

Orthographic projection- principles - Principal planes - First angle projection. Projection of points, Projection of straight lines, inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT III   DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS   9

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.

UNIT IV   FUNDAMENTALS OF AUTOCAD   9

Role of CAD in mechanical design, Getting started with AUTOCAD, Setting up drawing environment, Controlling drawing display, Using commands and system variables, Using co-ordinate systems, Creating objects, Drawing with precision, Editing methods, Using layers and object properties, Adding text to drawing, Creating dimensions, Using blocks, Creating layout to plot , Plotting your drawing.

UNIT V   APPLICATIONS OF AUTOCAD   9

Applications of AUTOCAD in various fields, Basic machine parts – drawing with conventions.

TOTAL :45 HOURS

TEXT BOOK :
1. Natrajan K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2009.
2. Gupta B.V.R. and M. Raja Roy, Engineering Drawing with AUTOCAD, I K International Publishing House Pvt. Ltd; 3rd Revised edition.

REFERENCES :
1. Bhatt N.D. and Panchal V.M., Engineering Drawing, Charotar Publishing House, 50th Edition, 2010.
2. Gopalakrishna K.R., Engineering Drawing (Vol. I&II combined), Subhas Stores, Bangalore,2007.
3. Luzzader, Warren. J. and Duff, John M., Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Kulkarni D.M., Engineering Graphics with AUTOCAD, Prentice Hall India Learning Private Limited (2010)

U19CSTL203T   C PROGRAMMING   L   T   P   C

Course Objectives:

The course aims to provide the students

- Write modular programs consisting of structure, functions and pointer concepts.
- Use structure variables for data storage and manipulation.
- Develop an application using strings.
- Gain knowledge about memory management in C.
- To learn the files and perform file manipulations

PREREQUISITES

- **U19CSTL101 -** Computational Thinking and Problem Solving

Course Articulation Matrix : 3- High, 2- Medium, 3- Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1									1		
CO2	2	1	1	1	2								2	3	1
CO3	3	2	2	1	3								1	2	
CO4	3	2	2	1	3								2	2	
CO5	2	1	1	1	2								2	3	
CO6	2	1	1	1	2								1	2	

| **UNIT I** | **INTRODUCTION: C PROGRAMMING** | **9** |

Structure of C program, Comments, Data types, Variables, Tokens: Keyword, Identifier, Constants, Operators, Expression and evaluation, Input and Output statements, Decision making-statements, Iterative statements, Storage Classes: auto, register, static and extern, Preprocessor Directives.

| **UNIT II** | **ARRAYS AND STRING** | **9** |

Introduction to arrays: Declaration, Initialization. One dimensional array Multi-dimensional arrays, Searching: Linear and Binary Search, Sorting: Bubble sort, Selection Sort. Introduction to string, Built in string functions, String manipulation with and without built in functions, Array of strings, Pattern matching application using strings.

| **UNIT III** | **FUNCTIONS AND POINTERS** | **9** |

Introduction to functions, Function prototype, Function definition, Function call, User defined functions and Standard functions (math function), Parameter passing: Call by value, Call by reference, Recursive functions, Passing arrays to functions, Command line arguments. Pointer in C, Importanceof pointer, Types of pointer, Pointer expression and arithmetic, Pointer and array, String as pointer,Pointer to function, Dynamic Memory Allocation

| **UNIT IV** | **USER DEFINED DATATYPES** | **9** |

Structure: Declaration, Accessing structure elements, Array of structure, Nested structure, Pointers to structure, Structure to function, typedef vs #define. Union: Declaration, Accessing union elements, Difference between structure and union, Enum and its uses

| **UNIT V** | **FILE HANDLING** | **9** |

Introduction to file, File Operations: Create, Open: File modes, Read, Write, Move, Close, File Processing: Sequential access and Random access.

Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to

APPROVED BY BOS CHAIRMAN

CO1: Explain the syntax for C programming
CO2: Associate the programs in 'C' for real world situation
CO3: Apply the concepts of Arrays, Strings in 'C' language for user defined problems.
CO4: Apply the concept of functions and pointers.
CO5: Associate the programs with structure using 'C' language.
CO6: Discuss to read and write data from/to files in 'C' Programs.

TEXT BOOKS:

T1: Programming in C, Ashok N. Kamthane, 2nd Edition ,Pearson Education India, 2011

T2: Behrouz A. Forouzan and Richard F. Filberg, "Computer Science A Structures Programming Approach using C", Third Edition, Cengage Learning, 2006.

REFERENCE BOOKS:

R1: A first book of ANSI C by Gray J.Brosin 3rd edition Cengage delmer Learning India P.Ltd

R2: Pradip Dey, Manas Ghosh, "Programming in C", second edition, Oxford University Press, 2011.

R3: Seyed H Roosta,"Foundations of programming languages design & implementation", Cengage Learning. 2009.

		L	T	P	C
U19CSTL203L	**C PROGRAMMING LABORATORY**	0	0	2	1

Course Objectives:

- Write modular programs consisting of structure, functions and pointer concepts.
- Use structure variables for data storage and manipulation.
- Develop application using strings.
- Gain knowledge about memory management in C.
- To learn the files and perform file manipulations

List of Programs

1.Solving simple problems with operators

2.Programs on conditional control constructs

3.Programs on loops (While, do-while, for)

4.Programs using user defined functions and library functions

5.Programs on arrays (Single , Multi- dimensional arrays)

6.Programs on   matrices

7.Programs on strings

8.Programs on   structures and unions.

9.Programs on files

10.Programs on Dynamic Memory allocation

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to,

CO1: Create and access user defined data types in C

CO2: Understand the memory allocation strategies in C.

CO3; Understand and apply various file handling and string functions in C.

CO4: Understand the concept of pointers and functions in C.

CO5: Choose and design a appropriate method to solve the problem

TEXT BOOKS

1. Programming in C, Ashok N. Kamthane, 2nd Edition, Pearson Education India, 2011
2. Behrouz A. Forouzan and Richard F. Filberg, "Computer Science A Structures Programming Approach using C", Third Edition, Cengage Learning, 2006.

REFERENCE BOOKS

1. A first book of ANSI C by Gray J.Brosin 3rd edition Cengage delmer Learning India P.Ltd

2. Pradip Dey, Manas Ghosh, "Programming in C", second edition, Oxford University Press, 2011.

3. Seyed H Roosta "Foundations of programming languages design & implementation", Cengage Learning. 2009.

U19FTTP202T	FOOD CHEMISTRY AND NUTRITION	L	T	P	C
		2	0	0	2

APPROVED BY BOS CHAIRMAN

Course Objective:
- To develop the knowledge of students in the basic area of Food Chemistry.
- To provide knowledge on classification, structure and properties of water and micronutrients
- To provide knowledge on classification, structure and properties of macronutrients
- To gain exposure on bioactive components and its application in food industries.
- To understand the metabolism and absorption of nutrients
- To provide more knowledge on nutritional composition of various food products

UNIT I   INTRODUCTION   9

Food Science: Importance of food, Scope of food science and chemistry - Introduction to food groups: classification and importance. Nutrients: Definition, classes of nutrients, calculating energy values from food, nutritional status, nutritional requirement, malnutrition, dietary recommendations. Balanced diet, food exchange lists; Digestion, Absorption and Transport of nutrients.

UNIT II   CARBOHYDRATES AND PROTEINS   9

Carbohydrates: Definition, classification, sources, structure, sensory properties - sweetness index, caramelization, Maillard reaction, nutritional and industrial importance, Sugar alcohols. Starches, Cellulose, Gums, and Pectin's. Thickening & gelatinization process, modified starch, Dextrin's and dextrans - nutritive value of starch in food.

Proteins: Structure, properties, nutritional aspects and sources. Amino acids, non-essential amino acids, essential amino acids, methods of protein evaluation - Biological Value (BV), Protein Efficiency Ratio (PER), functional role of proteins in food and industrial importance.

Lipids: Sources, structure and classification, properties, nutritional aspects – essential fatty acids, Polyunsaturated Fatty Acids (PUFA), MUFA, SCFA, LCFA, MCFA, hydrogenation, emulsification, Trans fats, rancidity, shortening value of different fats - low fat and no fat food, fat replacements, industrial importance of lipids.

UNIT III   WATER, VITAMINS AND MINERALS   9

Water: Structure of water molecule, types and properties of water, water activity and its importance, water quality for food processing - role of water in food preservation and shelf-life.

Vitamins and Minerals: Importance and sources of vitamins and minerals with special emphasis on calcium, iodine, zinc, iron, fluoride, fat soluble and water-soluble vitamins, effect of processing and storage on vitamins- stability & degradation in foods, deficiency disorders and requirements of different vitamins.

UNIT IV   FOOD PIGMENTS AND ENZYMES   9

Food Pigments: Importance, types and sources of pigments - their changes during processing and storage, carotenoids, tannins- Flavor and aroma components present in various foods, synthetic colours, artificial flavors, off flavors & food taints - stabilizers, preservatives, sweeteners.

Enzymes: Definition, nomenclature, classification, importance, sources - application of enzymes in food processing.

UNIT V   METABOLISM, CALORIFIC VALUE AND ENERGY BALANCE   9

Calorific value of foods: Definition, units – bomb calorimeter; energy requirements – basal metabolism, specific dynamic action of foods, direct and indirect calorimetry, physiological energy value of foods.

Energy Balance and Body Composition: Energy balance - body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control.

TOTAL: 45 HOURS

APPROVED BY BOS CHAIRMAN

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Understand the basic concepts of Food Chemistry

CO2: Acquire knowledge on classification, structure and properties of water and micronutrients

CO3: Have knowledge on classification, structure and properties of macronutrients

CO4: Gain exposure on bioactive components and its application in food industries.

CO5: Understand the metabolism and absorption of nutrients

CO6: Understand the proximate composition of various food products

Course Articulation Matrix : 3- High, 2- Medium, 3- Low

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	P
CO1	2	3	2	1									1		
CO2	2	1	1	1	2								2	3	
CO3	3	2	2	1	3								1	2	
CO4	3	2	2	1	3								2	2	
CO5	2	1	1	1	2								2	3	
CO6	2	1	1	1	2								1	2	

TEXT BOOKS

1. Srinivasan Damodaran, Kirk L. Parkin, Fennema's Food Chemistry, CRC Press, 2017.
   Chopra, H.K. and P.S. Panesar. "Food Chemistry". Narosa, 2010.
2. Meyer, Lillian Hoagland. "Food Chemistry". CBS Publishers, 1987.
3. Deman, John M. "Principles of Food Chemistry". 3rd Edition. Springer, 1999.
4. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". II Edition, Kluwer Academic, Springer, 2003.
5. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
6. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell, 2009.

REFERENCES

1. Vickie A. Vaclavik, Elizabeth W. Christain, Essentials of Food Science, Springer, 2013.
2. John M. deMan, John W. Finley, W. Jeffrey Hurst, Chang Yong Lee, Principles of Food Chemistry, Springer, 2018.
3. Gropper, Sareen S. and Jack L.Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

U19FTTL202L   **FOOD CHEMISTRY AND NUTRITION**   L   T   P   C
                   LABORATORY   0   0   2   1

Course Objectives:

- To perform quantification of major biomolecules present in food
- To explain the reaction mechanism of various molecules and substances used in food formulation
- To estimate proximate composition of given substances
- To evaluate the quality of oils and fats
- To measure and report the energy balance and nutrient level of foods

List of Programs

1. Qualitative tests for monosaccharide, disaccharides, polysaccharides
2. Estimation of reducing sugar by dinitro salicylic acid method
3. Estimation of starch by anthrone method
4. Estimation of amylose
5. Determination of iodine number
6. Extraction and estimation of oil content
7. Determination of saponification number
8. Estimation of moisture content, total ash and acid insoluble ash
9. Estimation of vitamins
10. Estimation of protein by biuret method
11. Estimation of minerals
12. Calculation and Computing of energy balance and nutrient composition of foods
13. Nutritional anthropometry - Standards for reference – WHO Growth Charts from birth to 18 years, Body Mass Index and reference value
14. Techniques of measuring height, weight, head, chest and arm circumference, waist to hip ratio, skin-fold thickness. Calculation of percent Body fat using skin folds calliper.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Perform quantification of major biomolecules present in food
CO2: Explain the reaction mechanism of various molecules and substances used in food formulation
CO3: Estimate proximate composition of given substances
CO4: Evaluate the quality of oils and fats
CO5: Measure and report the energy balance and nutrient level of foods
CO6: Estimate the total nutritional composition present in various food products

TEXT BOOKS

1. Weaver, C.M, and J.R. Daniel,(2005), The Food Chemistry Laboratory – A Manual for Experimental Foods, Dietetics & Food Scientists - 2nd Edition, CRC Press

U19FTTL203T   **UNIT OPERATIONS IN FOOD PROCESSING**   L   T   P   C
                   INDUSTRIES   3   0   0   3

Course Objectives:

- To impart knowledge on the principles of food process engineering and its significance in food Industry.
- To understand units, dimensions, formulas and able to solve problems related to food processing.
- To familiarize with food processing unit operations and provide knowledge on various unit operations involved in food industry.
- To understand the basic concepts of drying and milling techniques
- To gain knowledge on principles and unit operations involved in food industries.
- To understand the membrane separation and distillation techniques used in food processing sectors.

UNIT I   **9**

Unit operations in food processing – Drying – theory of drying, principles, Equilibrium moisture content, heat sources, types of dryers. Evaporation – definition – single and multiple effect evaporation-performances of evaporators and boiling point elevation – capacity – economy and heat balance– types of evaporators

UNIT II   **9**

Filtration – definition – filter media – types and requirements – constant rate filtration – constant pressure filtration – filter cake resistance – filtration equipment – rotary vacuum filter – filter press; sedimentation – gravitational sedimentation of particles in a fluid –Stoke's law, sedimentation of particles in gas – cyclones – settling under sedimentation and gravitational sedimentation; centrifugal separation– rate of separations – liquid-liquid separations –equipments; sieving, mixing and agitation of liquids.

UNIT III   **9**

Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products – energy and power requirements in comminuting – crushing efficiency – Rittinger's, Bond's and Kick's laws for crushing – size reduction equipment's – crushers – jaw crusher, gyratory crusher – crushing rolls – grinders – hammer mills – rolling compression mills – attrition, rod, ball and tube mills – construction and operation– size reduction of liquids – high pressure homogenization.

UNIT IV   **9**

Extraction process, rate of extraction, stage-equilibrium extraction, solvent extraction, supercritical fluid extraction, extraction equipment, washing, washing equipment. Membrane Separation: osmotic pressure, ultra-filtration, reverse osmosis, rate of flow through membranes. Van't Hoff equation, diffusion equations, Sherwood number, Schmidt number, membrane equipment.

UNIT V   **9**

Crystallization – rate of crystal growth – equilibrium crystallization – crystallization equipment – classification – construction and operation – tank, agitated batch, Swenson-Walker vacuum crystallizers – Distillation: Distillation process – binary mixtures – flash and differential distillation – steam distillation – theory – continuous distillation with rectification – vacuum distillation – batch and fractional distillation – operation and process – advantages and limitations – distillation equipment's – construction and operation – factors influencing distillation. Leaching: Principles of continuous leaching, counter current leaching, leaching equipment's.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Solve different food process engineering calculations.

CO2: Explain the principles of different types of evaporators and their application.

CO3: Acquire knowledge on importance of size reduction and energy requirement.

CO4: Learn the mechanism of crystallization, distillation and leaching process.

CO5: Comprehend the transformation of raw materials to quality food products using different processing technologies.

CO6: Summarize the knowledge on the various unit operation techniques involved in food processing sectors.

TEXT BOOKS

1. R.L. Earle, Unit Operations in Food Processing, Butterworth-Heinemann Ltd, 2nd Revised edition, Pergamon Press, 1983.
2. C.J. Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
3. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2001.

REFERENCES

1. J.M. Coulson and J.F. Richardson, Chemical Engineering, Volume I to V, The Pergamon Press, New York, 1999.
2. K. M. Sahay and K.K.Singh, Unit Operation of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
3. Albert Ibarz and G V Barbosa-Cánovas, Unit Operations in Food Engineering, Food Preservation Technology Series, CRC Press, London, 2003.

U19FTTL203L **UNIT OPERATION IN FOOD PROCESSING**   **L**   **T**   **P**   **C**
                                    INDUSTRIES LABORATORY   **0**   **0**   **2**   **1**

Course Objectives:

- To impart knowledge on the principles of food process engineering and its significance in food Industry.
- To understand units, dimensions, formulas and able to solve problems related to food processing.
- To familiarize with food processing unit operations and provide knowledge on various unit operations involved in food industry.
- To understand basic unit operations mainly involved in food processing sectors.
- To analyse the various separation and distillation involved in food industries.

List of experiments

1. Determination of dehydration rate of food products in a cabinet tray drier
2. Determination of economy and thermal efficiency of rotary flask evaporator
3. Determination of efficiency of liquid solid separation by filtration
4. Determination of separation efficiency of centrifugal separator
5. Determination of collection efficiency in cyclone separator
6. Determination of particle size of granular foods by sieve analysis
7. Determination of performance characteristics in size reduction using the burr mill
8. Determination of energy requirement in size reduction using ball mill
9. Determination of energy requirement in size reduction using hammer mill
10. Performance evaluation of pin mill
11. Performance evaluation of a steam distillation process
12. Visit to a sugar industry
13. Visit to dairy industry

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Solve different food process engineering calculations.

CO2: Explain the principles of different types of evaporators and their application.

CO3; Acquire knowledge on importance of size reduction and energy requirement.

CO4; Learn the mechanism of crystallization, distillation and leaching process.

CO5: Comprehend the transformation of raw materials to quality food products using different processing technologies.

CO6: Learn more knowledge on the basic concepts of distillation and separation techniques involved in food processing sectors.

TEXT BOOKS:

1. C.J. Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
2. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2001

U19METH301	APPLIED THERMODYNAMICS	L	T	P	C
		2	1	0	3

Course Objective
- To prepare them to apply those laws on use for various applications like IC engines, automobiles
- To make the students understand the pure substances and analyze the performance of thermodynamic air and vapor power cycles
- To familiarize the students on the basic principles of thermodynamics and the four laws of thermodynamics as well as their applications
- To understand the properties, gases and steam involved in food processing applications
- To impart knowledge on microscopic and macroscopic approaches in food.
- To understand the different case studies involved in food processing thermodynamics sectors.

UNIT I   BASIC   CONCEPTS   AND   FIRST   LAW   9

Concepts of continuum - Microscopic and macroscopic approach - Path and point functions - Intensive and extensive, total and specific properties - Thermodynamic equilibrium state, path and process - Quasi-static, reversible and irreversible processes - Heat and work transfer - P-V diagram - Zeroth law of thermodynamics – Concept of temperature and thermal equilibrium– relationship between temperature scales - First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes. **Case study:** Temperature measurement using thermometer, thermocouple and DBT, WBT measurements.

UNIT II   SECOND LAW AND AVAILABILITY ANALYSIS   9

Heat Reservoir, source and sink - Heat Engine and Refrigerator - Heat pump - second law and its corollaries - Carnot cycle - Reversed Carnot cycle – Performance - Clausius inequality - Entropy, T-s diagram, TdS Equations - pure substance, ideal gases - Principle of increase in entropy - Applications of II Law - High and low grade energy - Available and non-available energy of a source and finite body - Energy and irreversibility - Expressions for the energy of a closed system and open systems - Energy balance and entropy generation – Irreversibility - I and II law Efficiency. Third law of thermodynamics and its applications. **Case study:** Energy and Energy analyses of any live system, example IC engine

UNIT III   PROPERTIES OF PURE SUBSTANCES, IDEAL GASES AND STEAM   9

Ideal gas equation, Properties of Ideal Gases, Equations of State, Law of Corresponding States, Properties of Mixtures, compressibility, universal compressibility chart, Pure Substances, PVT Surfaces, PV, TV, and PT diagrams of water and other substances and differences of the same, phase-change processes, Concept of Vapor Pressure, Properties of steam, Saturation Temperature and Pressure, Use of property tables,TS diagrams, Mollier Chart. **Case study:** Demonstration of steam and its purposes in steam turbines

UNIT IV   THERMODYNAMICS   RELATIONS   9

Maxwell relations, TdS Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Joule Kelvin Effect, Clausius Clapeyron equation, Conditions of Thermodynamic Equilibrium and Stability, Simple Calculations **Case study:** Review of thermodynamic applications of the thermodynamic relations.

UNIT V   STEAM AND GAS POWER CYCLE   9

Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles. Air Standard Cycles - Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison. **Case study:** Evolve the effectiveness of the reheat and regenerative cycles.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1 : Illustrate basic concepts for solving problems in open and closed systems

CO2 : Apply second law of thermodynamics to heat engine and heat pumps as well as other applications

CO3 : Compare the performance of various vapor power cycles and their application

CO4 : Understand and illustrate the significance of thermodynamics relations in real life

CO5 : To be able to perform availability and energy analyses of a given system like IC engine

CO6: To understand the different concepts involved in thermodynamic relations

Course Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1	2	3	3	2	2									2	
2	2	1	1	2	3									1	
3	2	3	2	1	2									2	
4	3	1	2	2	3									2	
5	2	1		2	1									1	
6	3	2	2	1	2									2	

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS

1. Cengel Y Al and Boles M A Thermodynamics, An Engineering Approach Tata McGraw Hill, 2004.

2. Sonntag R E, Borgnakke C and Van Wylen G J, Fundamentals of Engineering Thermodynamics, John Wiley, 2003

REFERENCES

1. Nag P K, Engineering Thermodynamics, Tata McGraw Hill, Delhi, 2004.

2. Michael J Moran, Fundamentals of Engineering Thermodynamics, Wiley India Pvt. Ltd., 2010.

3. Holman J P, Thermodynamics, Tata McGraw Hill, 1998.

APPROVED BY BOS CHAIRMAN

U19CETH306   **PRINCIPLES OF FLUID MECHANICS**   **L   T   P   C**

                                                                                                      2   0   0   2

Course Objectives:
- To have an in-depth knowledge of fluid mechanics.
- To apply fluid mechanics to the area of food engineering.
- To perform basic design calculations for fluid flow in pipes
- To impart the knowledge of fluid flow properties involved in food processing sector
- To understand the concepts transportation of fluids in food industries
- To familiarize the principles and processing steps of flow properties.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2		2								3	
2	3	2	3	2	2	2	2							2	
3	1	3	2			2	1							1	
4	3	3	2	1	2	2	2							3	
5	2	3	3		3	2	2							3	
6	3	1	1	2		2								2	

3 - High, 2 - Medium, 1 – Low

UNIT I   FLUID STATICS AND DIMENSIONAL ANALYSIS   9

Nature of fluids – physical properties of fluids, Compressible and incompressible. Types of fluids – Newtonian and Non – Newtonian fluids. Fluid static: Hydrostatic equilibrium. Application of fluid statics: manometers, continuous gravity decanter. Basics of dimensional analysis: Rayleigh 's method and Buckingham's method.

UNIT II   BASIC EQUATIONS OF FLUID FLOW   9

Bernoulli equation. Correction of Bernoulli equation for fluid friction. Application of Bernoulli equation for pump work. Shear stress and skin friction in pipes. Laminar and turbulent flow of fluids through closed conduits. Velocity profiles and friction factor for smooth and rough pipes. Friction loss due to sudden enlargement, contraction. Friction loss in fittings, valves and coils.

UNIT III   FLOW PAST IMMERSED BODIES   9

Pressure drop for flow of liquids through porous media. Motion of particles through fluids: Equation for one dimensional motion of spherical particle through fluid, terminal velocity, Hindered settling. Agitation of liquids: Types of impellers, Flow pattern in agitated vessel. Power consumption in agitated vessels, blending and mixing.

UNIT IV   TRANSPORTATION OF FLUIDS   9

Fluid moving machinery. Performance – selection and specification. Positive displacement, centrifugal pump - characteristics. Gear pump, diaphragm pumps, vacuum pump, metering pump, peristaltic pump –working principle and application. Fans, blowers and compressors – Selection, types and applications.

UNIT V   METERING OF FLUIDS   9

Variable head meter: Orifice meter, Venturi meter, Pitot tube. Variable area meter: Rota meter. Calibration of flow meters. Principles and applications of Doppler Effect in flow measurement. Principle of Magnetic flow meters, V-Notch, Turbine flow meters, and Thermal flow meters. Valves – Types, applications.

TOTAL: 45 HOURS

Course Outcomes:

On successful completion of this course, the student will be able to :

CO1 : Recognize the various properties of fluids.

CO2 : Express the units of different properties of fluids.

CO3 : Describe the pressure and its measurement.

CO4 : Calculate the forces acting on bodies submerged in different positions in liquids.

CO5 : Identify the type of flow of fluid.

CO6: Summarize the different techniques involved in transportation of liquids in food processing industries

TEXT BOOKS

1. McCabe W.L., Smith J.C. and Harriot P., Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, New York, 2005.
2. Gavhane K.A., Unit Operations – I, 8th Edition, Nirali Prakashan Publications, Pune, 2000.

REFERENCES

1. Coulson J.M. and Richardson J.F., Chemical Engineering, Volume I, Pergamon Press, New York, 1977.
2. Noel de Nevers, Fluid Mechanics for Chemical Engineers, 2nd Edition, McGraw Hill, New York, 1991.
3. Cengel, Yunus and Cimbala John M., Fluid Mechanics Fundamentals and Applications, 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2006.

U19FTTL304T	DAIRY ENGINEERING	L	T	P	C
		2	1	0	3

Course Objective:

- To learn the physico-chemical and functional properties of milk constituents
- To understand the steps involved in the processing of milk and milk products
- To study the process in dairy plant
- To study the technology of making milk-based products
- To gain knowledge on microbiological properties of milk and their implications on processing and quality of dairy product
- To understand the processing and packaging of CIP in dairy industrial sector

UNIT I   INTRODUCTION AND PROPERTIES OF MILK   9

Indian Dairy industry, Milk - Definition, types of market milk, Composition of milk, Factors affecting composition of milk, System of pricing of milk, Nutritive value of milk, Physico-chemical properties of milk: Colour, Flavour, Specific Gravity, Boiling point, Freezing point, Refractive Index, Acidity and pH, Viscosity, Surface Tension.

UNIT II   RAW MILK COLLECTION, TRANSPORTATION AND RECEPTION   9

Raw milk collection system, Cooling and Transportation of milk, Platform tests of milk: Smell, Appearance, Temperature, Sediment, Acidity, Lactometer Reading, Fat, Solids-Not-Fat, Dye Reduction Test: MBRT test, Resazurin tests, Mastitis test, Filtration/Clarification of raw milk, Bactofugation of milk, Cooling and storage of raw milk, Bulk transportation technologies – carbon dioxide impregnation.

UNIT III   MILK PROCESSING, PACKAGING AND CIP   9

Milk Standardization, Milk Pasteurization: HTST/LTLT and Batch Pasteurization, Milk Sterilization UHT, Cream separation or Homogenization, Bottling/Packaging of milk, Liquid milk filling, Aseptic filling of milk. Basic principles, Cleaning and Sanitizing – agents and methods. Can washer - Rotary type and Straight through type. Selection and maintenance of can washers, CIP - Types of CIP system, Design of CIP system, CIP of dairy equipment's.

UNIT IV   EQUIPMENTS USED IN DAIRY PROCESSING   9

Selection of Accessories - Pipes, Aseptic valves, Filters, Pumps, Blenders, Storage Tank. Design of dairy equipments – Heat exchangers, Homogenizer, Spray dryer, Bulk coolers, Evaporators, Butter churner, Separators. Calculation of Refrigeration Load. Process Automation.

UNIT V   DAIRY PRODUCTS AND BY-PRODUCTS   9

Milk Products: Manufacture of cream, butter, butter oil/ghee, cheese, paneer, flavoured milk, ice-cream, yoghurt, condensed milk, milk powder, Khoa, peda, lassi, kefir, quark, Kulfi, milk sweets, whey, whey protein concentrate, casein, butter milk.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1 : Learn about the nutritional significance of milk and milk products

CO2 : Understand the colloidal nature of milk and its effect on quality attributes of dairy products

CO3 : Acquire knowledge on unit operations in milk processing viz., separation, standardization, homogenization, pasteurization, UHT, concentration, spray drying.

CO4 : Acquire knowledge on Dairy Microbiology

CO5 : Have an overall concept of Dairy industries.

CO6: Understand the CIP in processing and packaging dairy sector

Course Articulation Matrix   3- HIGH; 2 –MEDIUM; 1 –LOW

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	3	3	3		1		1	3	2	1	3
2	2	1	2	1	2				2		1	2	3	1	
3	3	1	2	2	3		3		1		1	2	3	2	2
4	2	1	2	2	1		1		1		3	2	1	1	3
5	1	2		2		2	3		1			2	2	1	3
6	3	2	2	2	3	1	3				1	3	1	2	3

TEXT BOOKS

1. Sukumar De, Outlines of Dairy Technology, Royal Oxford University Press, Delhi, 2010.
2. Tufail Ahmed, Dairy Plant Engineering and Management, Kitab Mahal, New Delhi, 2012.
3. Jane Selia dos Reis Coimbra, Jose A. Teixeira, Engineering Aspects of Milk and Dairy Products CRC Press, New York, 2010.

REFERENCE BOOKS

1. Robinson R.K., Modern Dairy Technology: Advances in Milk Products, Volume 2, Springer London Ltd., 2012.
2. Hui,Y.H,, Dairy Science and Technology Handbook: Applications Science, Technology and Engineering, Volume 3, Wiley, New Delhi, 2014.

U19FTTL304L	**DAIRY ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objectives:
- Understand physico-chemical and colloidal properties of milk
- Gain awareness on microbiology of raw milk and their implications on safety standards of milk and milk products
- Familiarize with unit operations in milk processing: separation, standardization, homogenization, pasteurization, UHT, concentration, spray drying.

List of experiments
1. Studies on milk sampling, judging and grading of milk.
2. Determination of acidity, specific gravity and clot-on-boil test of milk.
3. Determination of fat, SNF and total solids content in milk.
4. Determination of MBRT and alcohol index test of milk.
5. Determination of pasteurization efficiency of milk in plate heat exchanger.
6. Estimation of homogenization efficiency
7. Detection of adulterants in milk.
8. Determination of surface tension of milk.
9. Determination of total milk protein content in milk.
10. Determination of churning efficiency of butter churner.
11. Determination of efficiency of spray dryer
12. Determination of separation efficiency of cream separator.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Recognize the role of dairy foods in human nutrition

CO2: Equip with skills required for purchase, storage and processing of Milk and Milk Products

CO3: Assess the safety and quality factors that determine the acceptability of the dairy products by consumers

U19FTTL305T **FOOD BIOCHEMISTRY** **L T P C**

2 1 0 3

Course Objective:

- To understand the fundamental role of macromolecules in various food process operations
- To evaluate biochemical changes during food storage and preservation.
- To analyze the applications of various macromolecules such as carbohydrates, proteins and lipids etc.,
- To impart knowledge on biochemical changes in food processing and preservation
- To understand the different storage techniques involved in food sector
- To analyse the various byproducts of food industries

UNIT I BIOCHEMISTRY OF MACRONUTRIENTS DURING PROCESSING 9

Biochemical changes in carbohydrates, proteins and lipids-parboiling of rice, caramelization of sugars, browning and maillard reactions. Loss of nutrients and prevention of loss during cooking. Anti-nutritional factors and their elimination.

UNIT II BIOCHEMICAL CHANGES DURING STORAGE 9

Biochemical changes during storage of food grains, fruits and vegetables. Cold storage and freezing of foods – factors affecting quality of foods – biochemical changes.

UNIT III BIOCHEMICAL CHANGES DURING FOOD PRESERVATION 9

Biochemical changes during processing of foods – drying, pickling, baking and malting. Biochemical changes during minimal processing methods. Chemistry of food additives, flavour and colouring agents (natural and synthetic). Biochemical changes during food preservation – structure and mechanism of action of preservatives.

UNIT IV INDUSTRIAL APPLICATION OF CARBHOHYDRATES 9

Isolation and purification of starch – uses of starch in food industry, pectin's and gums as stabilisers in food industry. Resistant starch. Modifications of starch. Sweeteners and sugars in foods – structure – activity – relationship.

UNIT V PROTEIN, ENZYMES – INDUSTRIAL APPLICATIONS 9

Isolation of protein from soybean, milk and egg; protein hydrolysates, modification of proteins, storage and stability of proteins. Enzymatic action of post-harvest and post-mortem foods. Enzymes in food industry – amylase, glucoamylase, cellulase, polygalacturonase, protease, lipase. Enzyme immobilisation.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1 : Analyze the fundamental roles of macromolecules in various food process operations
CO2 : Evaluate biochemical changes during food storage and preservation
CO3 : Apply the principles and concepts of protein and enzymes in food processing and preservation
CO4 : Understand the nature of food in terms of its Biochemical aspects.
CO5 : Overall understanding of Biochemical aspects, as needed for industries.
CO6: Understand the carbohydrates, proteins and different enzymes involved in food industrial applications

Course Articulation Matrix   3 – HIGH; 2 – MEDIUM; 1 –LOW

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2		2		1		1	2	2	2	
2	2	1	2	2	3		2		1		1	2	2	2	1
3	3	2	1	2	1		1		2		2	3	1	2	3
4		2	2	1	1		2		1		1	2	1	2	1
5	1	2	2	3	2		1		2		1	2	2	1	2
6		2	2	3	2		2		1		1	2	1	3	2

TEXT BOOKS

1. Cox, M.M. and Nelson, David L. Leininger, "Principles of Biochemistry". 5th Edition. H.Freeman , 2008
2. Murray, Robert K. *etal.*, "Harper's Illustrated Biochemistry" 27th Edition. McGraw-Hill,2006

REFERENCE BOOKS

1. Nelson D.L., M.M. Cox, Lehninger Principles of Biochemistry, W.H. Freeman & Company Publications, 2013. ISBN-10: 1-4292-3414-8
2. Tymoczko, J.L., Berg, J.M., Stryer, L. Biochemistry – A short course, 3rd edition. W.H. Freeman. 2009. ISBN-10: 1-4641-2613-5
3. SunetraRoday., "Food Science and Nutrition – 2nd edition, Oxford Higher Education/Oxford University Press, 2012, ISBN 10: 0198078862

APPROVED BY BOS CHAIRMAN

U19FTTL305L   **FOOD BIOCHEMISTRY LABORATORY**   L   T   P   C
                                                                 0   0   2   1

Course Objectives:
- To gain knowledge of practices for proper literature reviews and evaluation of appropriate methods for analysis.
- To understand proper use of methods of analysis
- To interpret various methodologies for analysis of components in foods.

List of Programs
1. 1. Extraction and estimation of starch
2. Determination of dextrose equivalent
3. Estimation of crude fibre
4. Estimation of non-enzymatic browning in foods
5. Extraction and estimation of chlorophyll
6. Extraction and estimation of carotenoids and lycopene
7. Isolation of protein from milk and egg
8. Determination of peroxide value of oil
9. Determination of TBA value of oil
10. Extraction and estimation of polyphenols
11. Extraction and estimation of flavonoids
12. Determination of titratable acidity, sugar acid ratio and pH of food products

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Demonstrate the presence of protein, lipid, carbohydrate and water in food using chemical methods

CO2: Describe various separation and quantification techniques frequently used for food analysis.

CO3: Evaluate proper selection and application of appropriate methods of analysis.

CO4: Identify of how analytical techniques may be used to determine food composition and quality

CO5: Apply their knowledge in food biochemistry and nutrition in designing new range of products with improved nutritional characteristics

U19CCLC301	CAREER ENHANCEMENT PROGRAM – I	L	T	P	C
		0	1	2	1

Course Objectives:

- To develop active listening skills in various contexts.
- To develop the student's ability to use English accurately, appropriately, and fluently in different social and professional situations.
- To enable students to gain a strong foundation by expanding their logical, numerical, and reasoning skills.
- To ensure students develop the ability to comprehend, work with, and apply general mathematical techniques and models to different situations.

Course Outcomes:

At the end of the course, learners will be able to

C01: Listen and comprehend technical and non-technical spoken experts critically and functionally.

C02: Able to use English accurately, appropriately and fluently in different social and professional situations

C03: Able to gain a strong foundation by expanding their logical, numerical and reasoning skills.

C04: Ability to comprehend, work with, and apply general mathematical techniques and models to different situations.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										3		2			1
2							2		2	3		2			2
3	3	2				2			1			2	2	3	
4	2	2						2				2			3

3 - High, 2 - Medium, 1 – Low

UNIT I 9

Applied Language Skills: Pronunciation - Homophones/ Homonyms / Homographs - Listening to the Busin conversations and answering MCQs Quants: Number Series - Sequence - Alphabet Series - Odd man out.

UNIT II 9

Applied Language Skills: Telephone Etiquette - Understanding the tone - Listening to a Telephone conversation and filling out the forms Quants: Seating Arrangements - Linear, Circular, Square, Rectangular Arrangement

UNIT III 9

Applied Language Skills: Idioms & Phrases - Phrasal Verbs - Listening to Self-introductions /conversations - Understanding the structure of the speech Quants: Family Tree- Statement Problems on Blood Relations - Direction Problems – Left Right Movement – Clockwise – Anti-clockwise.

UNIT IV 9

Applied Language Skills: Listening to describing the products - Interpretation of Charts- Usage of discourse markers Quants: LOGICAL DEDUCTION - Introduction to Sets-Venn Diagrams – Logic-based questions using Venn diagram - Rules for solving syllogism questions-Statement and conclusion.

UNIT V 9

Applied Language Skills: Strategies for presentation - Practice- Decision Making – Problem-Solving - Taking up a Listening Test Quants: CLOCKS AND CALENDAR - Minute Spaces - Hour Hand and Minute Hand - Odd Days - Leap Year –Ordinary Year - Counting of Odd Days

TOTAL: 45 HOURS

TEXTBOOKS

1. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage learning,USA: 2007
2. Redston, Chris & Gillies Cunningham. Face2Face (Pre-intermediate Student's Book). Cambridge University Press, New Delhi: 2005
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand& Co Ltd., New Delhi.
4. Pearson Publication, "A Complete Manual for the CAT", 2018

REFERENCES

1. Carter, R., & McCarthy, M. (2006). Cambridge grammar of English: A comprehensive guide: spoken and written English grammar and usage. Cambridge University Press.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014

WEB RESOURCES

https://learnenglish.britishcouncil.org/skills/listening

https://ieltspolska.pl/wp-content/uploads/2020/05/Listening-paper-assets.pdf

https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=listening

https://testbook.com/aptitude-practice

https://www.indiabix.com/aptitude/questions-and-answers/

APPROVED BY BOS CHAIRMAN

U19MATL302   **PROBABILITY AND NUMERICAL METHODS**   L   T   P   C
                                                        3   0   2   4

Course Objectives:

Engineering Mathematics is an essential tool for describing and analyzing engineering process and systems. It enables precise representation and technology of knowledge. The objective of this course is to familiarize the Food technologists with techniques of Probability, One dimensional random variable, Standard distributions, Solution of equations and Numerical differentiation and integration which are being widely used in Food technology. In addition, this course provides the MATLAB techniques for solving the mathematical problems.

PREREQUISITES

- Basic concepts of Probability
- Differentiation
- Integration

THEORY COMPONENT CONTENTS

UNIT I   PROBABILITY   9

Probability – Axioms of probability – Conditional probability – Baye's theorem – Applications of Probability in Food Technology.

UNIT II   ONE DIMENSIONAL RANDOM VARIABLES   9

Random variable – Discrete random variable – Probability mass function – Continuous random variables – Probability density function – Distribution function – Moments – Moment generating functions – Properties (statement only) – Applications of One Dimensional Random Variables in Food Technology.

UNIT III   STANDARD DISTRIBUTIONS   9

Discrete distributions – Binomial, Poisson, and Geometric distributions - Continuous distributions – Exponential and Normal distributions – Moment generating functions – Properties (statement only) – Problems – Applications of Standard Distributions in Food Technology.

UNIT IV   SOLUTION OF EQUATIONS   9

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods – Gauss Seidel – Applications of Solution of Equations in Food Technology.

UNIT V   NUMERICAL DIFFERENTIATION AND INTEGRATION   9

Approximation of derivatives using interpolation polynomials – Newton's forward and backward difference formulae – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Evaluation of double integrals by Trapezoidal – Applications of Numerical Differentiation and Integration in Food Technology.

                                                                Total:45 HOURS

Course Outcomes:

At the end of the course students should be able to,

CO1   Apply the concepts of probability for solving the engineering problems.
CO2   Analyze the probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
CO3   Analyze the problems which involve uncertainties through the standard distribution.
CO4   Solve the transcendental equations and system of equations by using different numerical techniques.
CO5   Apply numerical techniques for solving the problems involving a differentiation and Integration concepts.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
CO s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
CO1	3	3	2		2							2	2	2	2
CO2	2	2	2		2							2	2	2	2
CO3	3	3	2		2							2	2	2	2
CO4	3	3	2		2							2	2	2	2
CO5	3	3	2		2							2	2	2	2

TEXT BOOKS

T1.   Grewal. B.S., and Grewal. J.S., "Higher Engineering Mathematics",   Khanna Publishers, 44th Edition, New Delhi, 2015.

REFERENCE BOOKS

R1.   Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.

R2.   Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

R3.   Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage
 Learning, New Delhi, 8 th Edition, 2012.

R4.   Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd
Edition, Elsevier, 2004.

R5.   Grewal. B.S., and Grewal. J.S., "Numerical methods in Engineering and Science",
Khanna Publishers, 43th Edition, New Delhi, 2015.

LAB COMPONENT CONTENTS
PROBABILITY AND NUMERICAL METHODS LABORATORY

Work sheet No.	Programming Name
	Introduction to MATLAB
1.	Arithmetic Operators – Addition, Subtraction, Multiplication and Division
2.	Matrix Operators – Addition, Subtraction, Multiplication, Transpose, Inverse and Rank
3.	Array Operators – Array Multiplication, Array division, Array power and Array Transpose
4.	Calculate the roots of the polynomials.
5.	Solve exponential, trigonometric and logarithmic functions.
6.	Solve the system of linear equations.
7.	Evaluate Indefinite Integrals of the given function.
8.	Evaluate Definite Integrals of the given function.
9.	Solve the Double Integral problems.
10.	Solve the integration problems using Trapezoidal rule
11.	Solve the double integration problems using Trapezoidal rule.
12.	Solve the integration problems using Simpson's 1/3 rule.

Total:45HOURS

APPROVED BY BOS CHAIRMAN

U19EETL301T   BASICS OF ELECTRICAL AND ELECTRONICS   L   T   P   C
ENGINEERING   2   0   0   3

Course objectives:
- To understand electric circuit laws, single and three phase circuits and wiring
- To learn the working principles of electrical machines
- To understand the working principle of various electronic devices and measuring instruments
- To understand the renewable and non-renewable power systems
- To know basic knowledge on basic electronics and digital circuits

UNIT I   INTRODUCTION TO POWER SYSTEMS   9

Introduction: Electric Potential, Current, Power and Energy. Generation of Electrical Energy: Sources of Energy - Renewable and Non-Renewable - Power Generation: Thermal, Hydro and Nuclear Power plants - Solar and Wind (schematic arrangement and operation) Power plants - Structure of Electric Power System - Transmission and Distribution Voltages. Electrical Safety Aspects - Phase-Neutral - Earthing: Need for Earthing and Types - Domestic Wiring (Simple and staircase) - Energy Conservation and Sustainability.

UNIT II   DC CIRCUITS AND AC CIRCUITS   9

Resistance: Resistors in Series and Parallel - Network Reduction - Voltage and Current Division Rule - Ohm 's Law- Kirchhoff 's Laws - Mesh Analysis of Simple Resistive Networks. Single phase systems: Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor - AC Series Circuits (RL, RC & RLC). Three phase Systems (Qualitative only): Star and Delta Connected Systems - Line and Phase Voltage/Current - Three Phase Power Measurement by Two Wattmeter Method.

UNIT III   ELECTRICAL MACHINES   9

DC Machines: Construction, Principle of Operation of DC Motor-Torque Equation, Types and Applications. AC Machines: Construction and Working Principle of AC Generator, Single Phase Transformer, Three Phase Induction Motor and Single-Phase Induction Motor (Split Phase and Capacitor Start Induction Motor) - Applications.

UNIT IV   BASIC ELECTRONICS   9

PN Junction Diode - Operation of Rectifiers (Half wave, Full wave - Bridge Rectifiers with waveforms) and Filters - Zener Diodes - Zener Diode as Voltage Regulator - IC Voltage Regulators (78XX & 79XX) - Transistors: Types - Operation of NPN Transistor - Transistor as an Amplifier - Operation and Characteristics of SCR - UPS and SMPS (Block Diagram approach).

UNIT V   DIGITAL ELECTRONICS   9

Introduction – Binary Number Systems and Conversions - Binary Addition and Subtraction - Logic Gates and Truth tables - Boolean Algebra - Basic Laws and Demorgan's theorem - Simplification of Boolean Functions - Full Adder and Full Subtractor - Flip Flops - Counters: Asynchronous Binary Ripple Counter

TOTAL: 45 HOURS

Course Outcomes:
At the end of the course, learners will be able to:
CO1: Understand electric circuits and working principles of electrical machines
CO2: Understand the concepts of various electronic devices
CO3: Choose appropriate instruments for electrical measurement for a specific application
CO4: Understand the basic on renewable and non-renewable power systems
CO5:Understand the different voltages, torque and rectifiers
CO6: Analyse the basic number systems and conversions of digital electronics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										3		2			1
2							2		2	3		2			2
3	3	2				2			1			2	2	3	
4	2	2						2				2			3

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS

1. 1. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint, 2016.
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

REFERENCES

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007.
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006.
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006.
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006.
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009.
6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India) Private Limited 2016.

		L	T	P	C
U19EETL301L	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**0**	**0**	**2**	**1**

Course Objectives:

• To provide exposure to the students with hands on experience on basic engineering practices in Electrical and Electronics Engineering.

List of experiments

1. Control of incandescent and fluorescent lamp by simple and stair-case wiring
2. Resistor colour coding and verification of Ohm 's Law and Kirchhoff 's Laws
3. Measurement of real power, reactive power, power factor and impedance of RC, RL and RLC circuits.
4. Measurement of Earth 's resistance
5. Load test on DC shunt motor
6. Performance characteristics of single-phase Transformer
7. Load test on single phase induction motor.
8. Verification of basic logic gates and their truth tables.
9. Implementation of Half wave and Full wave Rectifier with simple Capacitor Filter
10. Study of Mixie, Ceiling Fan and Vacuum Cleaner, Grinder

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Carry out basic home electrical works and appliances

CO2: Measure the electrical quantities

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				L	T	P	C
U19CCEX303	**ENGINEERING EXPLORATION III**			0	0	2	1

Course Objectives:

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

PRE-REQUISITES

NIL

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

Course Outcomes:

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix   3 – HIGH; 2- MEDIUM; 1- LOW

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

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U19MATL404	**STATISTICS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES

Engineering Mathematics is an essential tool for describing and analysing engineering process and systems. It enables precise representation and technology of knowledge. The objective of this course is to familiarize the Food technology engineers with techniques of Statistical measures, Correlation and Regression, Testing of hypothesis, Design of experiments and Statistical quality control which are widely used in Food technology. In addition, this course provides the MATLAB techniques for solving the mathematical problems.

PREREQUISITES
- Basics Concepts of Probability.

THEORY COMPONENT CONTENTS

UNIT I   STATISTICAL MEASURES   9

Measures of central tendency: Arithmetic Mean, Median, and Mode – Measures of variations: Range, Mean deviation, Standard deviation and coefficient of variation – Applications of Statistical measures in Food technology.

UNIT II   CORRELATION AND REGRESSION   9

Correlation (Discrete Data) – Karl Pearson's Correlation coefficient – Spearman's Rank Correlation – Linear Regression lines (Discrete Data) – Applications of Correlation and regression in Food technology.

UNIT III   TESTING OF HYPOTHESIS   9

Sampling distributions (concepts only) – Statistical hypothesis – Large sample tests based on Normal distribution for single mean and difference of means – Small sample tests based on t – test for single mean, and difference of means and F distribution for difference of variances – Applications of Testing of Hypothesis in Food Technology.

UNIT IV   DESIGN OF EXPERIMENTS   9

Analysis of variance – One-way classification – Completely Randomized Design (CRD) – Two-way classification – Randomized Block Design (RBD) – Latin square Design – Applications of Design of Experiments in Food Technology.

UNIT V   STATISTICAL QUALITY CONTROL   9

Control Charts for measurements ($\overline{X}$ and R Charts) – Control Charts for Attributes (p, c and np charts) – Applications of Statistical Quality Control in Food Technology.

Total:45HOURS

Course Outcomes:

At the end of the course students should be able to

CO1	Understand the concept of measures of central tendencies.
CO2	Apply the concepts of correlation and regression in engineering problems.
CO3	Apply the concept of testing of hypothesis for small and large samples in the problems which occur in the real life problems.
CO4	Apply the concepts of classifications of design of experiments in the field of Food technology.
CO5	Analyze the charts and statistical techniques which are used in engineering and management problems.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW													CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
CO s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2		2							2	2	2	2
CO2	3	3	2		2							2	2	2	2
CO3	3	3	2		2							2	2	2	2
CO4	3	3	2		2							2	2	2	2
CO5	3	3	2		2							2	2	2	2

TEXT BOOKS:

T1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund 's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.

T2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCE BOOKS

R1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2016.

R2. Gupta.S.C and Kapoor V.K, "Fundamentals of Mathematical statistics", , Sultan Chand & Sons,2007.

R3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.

R4 Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4rd Edition, Elsevier, 2009.

R5 Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, 4th Edition, 2012.

R6 Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2017.

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LAB COMPONENT CONTENTS

STATISTICS LABORATORY

Work sheet No.	Programming Name
	Introduction of the Statistics toolbox.
1.	Find the mean, median and mode of the given data.
2.	Create a matrix and compute its variance and standard deviation of each column (or) row.
3.	Write a program to find the Covariance between two random variables.
4.	Write a program to find the Correlation coefficients between two random variables.
5.	Write a program to find an ANOVA table of one way classification.
6.	Write a program to find an ANOVA table of two way classification.
7.	Write a program to find an ANOVA table of N way classification.
8.	Write a program for testing of Hypothesis for Mean and Difference of means for large samples.
9.	Write a program for testing of Hypothesis for Mean and Difference of means for small samples.
10.	Write a program for testing of Hypothesis for variances of small samples.
11.	Create $\overline{X}$ and R control charts for the given data.
12.	Create p, c and np control charts for the given data.

Total:45 HOURS

U19METL403T **THEORY OF MACHINES** **L** **T** **P** **C**

  3 **0** **0** **3**

Course Objectives

- To impart knowledge on the fundamental concepts of Mechanisms
- To analyze the kinetics of motion and friction, mechanism of engine
- To understand the mechanism of belt and chain drives
- To understand and differentiate the terminologies involved in machines
- To understand the different mechanisms involved in theory of machines
- To learn the basic concepts on the transmission by gears and cams

UNIT I **ANALYSIS OF MECHANISMS** **9**

Basic concept of machines – Kinematics – links – pairs – chain-machines and mechanisms. Different mechanisms and uses-Inversion of mechanisms-Four bar linkage-its inversions. Different techniques of obtaining velocity and acceleration in different mechanisms.

UNIT II **KINETICS OF MOTION AND FRICTION** **9**

Kinetics of motion – principles of conservation of energy and momentum – drive torque in geared system. Friction-concepts – sliding of a body on horizontal and inclined plane - pivot and collar friction – bearing – types-loss of power due to friction in bearings-Basic theory of lubrication-viscosity ratings-Antifriction bearings-types. Brake – types-calculation of breaking effort for simple braking systems -clutches types-single and multiple disc cone and their applications.

UNIT III **POWER DRIVES** **9**

Power transmission by belt – expression for tension ratio – belt tension-belt drive- ratio of driving tensions. Chain Drives-terminology – chain classification – chain length determination – sprocket terminology.

UNIT IV **MECHANISM IN ENGINES** **9**

Governor-watt and porter governor-principle of operation sensitivity and hunting- power and effort. Turning moment diagram and flywheel-function fluctuation of speed and energy.

UNIT V **TRANSMISSION BY GEARS AND CAMS** **9**

Cam and follower – types – application-profiles for uniform velocity and acceleration simple harmonic and cycloidal motion – uniform angular velocity. Gears – classification-terminology – profile-law of gearing-minimum number of teeth-interference between rack and pinion-efficiency-gear trains-simple compound-reverted.

  TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Apply fundamentals of dynamics analysis to various mechanical systems.

CO2: Design and analyze gears and cams.

CO3: Perform power measurement using dynamometers.

CO4: Understand the basic concepts on the different types of bearings

CO5: Classify the various chain drives and belt terminology

CO6: Understand the types and applications of kinematics in machines

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1										3		2			1
2							2		2	3		2			2
3	3	2				2			1			2	2	3	
4	2	2						2				2			3

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS

1. Rattan S.S, "Theory of Machines" Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition. 2005.
2. Sadhu Singh, "Theory of Machines," Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2nd Editon. 2006
3. Jagadish Lal, 'Theory of Machine', Dhanpat Rai Publications, New Delhi.

REFERENCES

1. Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" Oxford University press.2004
2. "Theory of Machines -I", by A.S. Ravindra, Sudha Publications, Revised 5th Edition.2004.

U19METL403L	THEORY OF MACHINES LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- To improve problem solving ability of students on various problems related to engine mechanism

LIST OF EXPERIMENTS

1. Drawing of locus points in four bar and slider crank mechanisms
2. Determination of velocity by vector polygon method
3. Determination of acceleration in mechanism
4. Determination of acceleration in scotch yoke and shaper mechanisms
5. Problems on kinetics of motion
6. Problems on clutches
7. Problems on brakes
8. Problems on belt transmission and transmission chain
9. Problems on gear trains
10. Problems on gear tooth profile
11. Problems in governors
12. Problems on fly-wheels
13. Balancing of masses on single and multiple planes

TOTAL: 45 HOURS

Course Outcomes

Upon completion of this course, the student will be able to

CO1: Practically apply the gained knowledge on solving real time problems

REFERENCE BOOKS

1. Shigley. J.E. & Nicker.J.J., 1995. "Theory of Machines and Mechanisms" end Edition, McGraw-Hill Inc.
2. Ghosh A & Malik A.K., 1988. "Theory of Mechanisms and Machines", Affiliated East West Press (P) Ltd.
3. Ballaney, P.L., 1994. "Theory of Machines", Khanna Publishers, New Delhi.
4. Rattan, S.S. "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi. 5. Khurni, R.S. and Gupta, J.K. 1994. "Theory of Machines", Eurasia Publishing House, Calcutta.

APPROVED BY BOS CHAIRMAN

U19FTTL401T   POST-HARVEST TECHNOLOGY OF CEREALS,   L   T   P   C
**   PULSES, MILLETS AND OIL SEEDS   3   0   0   3**

Course Objectives

- To introduce the properties of grains and their storage.
- To understand the specific aspects of milling techniques related to cereals and pulses.
- To understand the extraction and refining of oil from oil seeds.
- To understand the harvesting and threshing techniques involved in pre-harvest technology
- To impart the knowledge on the grading and quality structures of storages
- To understand the different extraction and physiochemical properties of oil extraction

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	1		2	1	1	3	2	2	1	2
2	3	1	2	2	2			2	1		2	1	2	2	1
3	2	2	1	3	1			2	1	2	3	2	1	1	
4	3	1		2	2		3		1		2	3	2		2
5	1	2		1	2		1		2	1	2	1	2		2
6	1	2	2		2		1		1		2	3	1		1

3 - High, 2 - Medium, 1 – Low

UNIT I   GRAIN PROPERTIES, HARVESTING AND THRESHING   9

Importance of grains and cereals – definitions and its nutritional value. Structure and composition of grains, pulses and oilseeds, Physicochemical and thermal properties of cereals and pulses. Harvesting and threshing of grains and pulses. Grading. Storage of cereal grains in relation to maintaining grain quality – types of storage structures – traditional and modern.

UNIT II   DRYING AND MILLING OF RICE   9

Grain drying – principles, grain drying systems, commercial grain dryers. Rice milling flow sheet. Explanation of steps in milling operations - Cleaning, Parboiling- Physio –chemical changes during Parboiling and effects of qualities of rice. Methods of Parboiling, Milling, Shellers, Paddy Separator, Whitener, Polisher, Grader, and modern rice mill. By-products from rice milling and waste utilization.

UNIT III   DEHULLING, SPLITTING AND MILLING OF PULSES   9

Importance of legumes. Milling and processing of Legumes- Methods of milling of pulses. Processing methods- dehulling losses and effect of dehulling on nutritive value. Grading methods, Cooking quality.

UNIT IV   MILLING OF OIL SEEDS   9

Oil seed processing- natural sources of oil. Physio-chemical properties, mechanical extraction - Oil processing machinery, solvent extraction, factors influencing extraction, types of solvents. Refining of oil, hydrogenation, winterization, changes during storage. Oil seed flour concentrates and isolate.

UNIT V   SPECIALITY MILLING   9

Wheat milling flow sheet. Explanation of steps in milling, Cleaning Principles of Parboiling of wheat-Methods of Parboiling, Sifters, De-stoners, Roller milling - Break rolls, and reduction rolls, Sifting and purifying, plan sifters. Bran separation. Efficiency of milling process. By products from wheat milling and waste utilization. Milling of Corn: Corn–types. Dry and wet milling of corn–flow sheet and explanation, By-products from corn milling, corn starch, corn syrup, corn flakes. Waste utilization.

TOTAL: 45 HOURS

Course Outcomes

On completion of the course, the students will gain knowledge on

CO1: The specific processing technologies used for cereals, pulses and oil seeds

CO2: Developing competence in processing of Cereals, Pulses and Oilseeds technology.

CO3; Different storage structures and protection of stored grains.

CO4: Understand the basic concepts of milling technology

CO5: Analyse the different byproducts involved in milling stages of cereals, pulses and millets

CO6: Understand the various milling methods, grading and quality of grain technology

TEXT BOOKS

1. Chakraverty, A. Post-Harvest Technology of Cereals, Pulses and Oil Seeds, Third Edition,
2. Oxford & IBH publishing & Co., New Delhi, 2000. Sahay, K.M. and Singh. K.K. Unit operations of Agricultural Processing, Vikas Publishing House, New Delhi, 1996.

REFERENCE BOOKS

1. Kulp K and Pont J G, Handbook of Cereal Science and Technology, Second Edition, Chips Ltd. USA, 2000.
2. Khader, Vijaya and Vimala, V., Grain Quality and Processing, Agrotech Publishing, Udaipur, 2007.
3. Harry Lawson. Food Oils and Fats, Technology, Utilization and Nutrition, CBS Publishers and Distributors, New Delhi, 1997.

U19FTTL401L	POST HARVEST TECHNOLOGY OF CEREALS, PULSES AND OIL SEEDS LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- To create awareness about the processing of major cereals like paddy, maize and oil seeds
- To study about the by-products obtained during processing along with their uses.
- To gain knowledge and processing, milling and quality of pulses

List of Experiments

1. Determination of Bulk density, Tabbed, Carr's index and Hausner ratio of Wheat flour

2.Determination and testing of groundnut decorticator

3. Determination of performance characteristics in size reduction of food grain using burr mill

4.Determination of porosity for grains

5. Determination of particle size by granular foods by using sieve analysis

6.Determination of energy requirement in size reduction using hammer mill

7.Determination of angle of repose for grains

8.Determination of moisture content by direct method

9.Determination of oil content in oil seed using expeller

10.Estimation of water absorption power for flour

11. Study soya bean oil processing

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Aware the importance of physico-chemical properties of cereals and pulses

CO2: Understand the basics of milling and sieving operation for food grains

CO3: Identify the problems associated with milling of grains and their solutions

CO4: Know processing food grains into value added products

APPROVED BY BOS CHAIRMAN

U19FTTL406T   **FOOD MICROBIOLOGY**   **L   T   P   C**
                                                                          3   0   0   3

Course Objectives

- To understand the microorganisms associated with foods
- To learn the fermentation process and microorganisms involved in the production of fermented foods
- To know the role of microbes in food spoilage and preservation of foods.
- To impart the basic knowledge on and isolation methods of microorganisms from foods
- To understand the food borne infections involved in various food products
- To know the enumeration of microbial safety and regulations

UNIT I   MICROORGANISMS IN FOOD   9

History of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, principles of staining techniques. Nutritional requirements of bacteria, media used for bacterial culture, growth curve and methods to quantify bacterial growth, Importance of microorganisms in food – primary sources of microorganisms in food – intrinsic and extrinsic parameters of food affecting microbial growth – types of microorganisms in foods like meat, poultry, seafood, vegetables, dairy products, fruits and vegetables.

UNIT II   MICROBIAL SPOILAGE OF FOODS   9

Spoilage of foods – principles and types of spoilage – microbial spoilage of different types of foods – spoilage of fruits and vegetables, fresh and processed meats, poultry, sea foods, cereals, flour, dough, bakery products dairy products. Use of antimicrobial agents, naturally occurring antimicrobials Assessing microbial load in foods – microscopic, cultural, physical, chemical and immunological methods

UNIT III   ISOLATION AND ENUMERATION OF MICROORGANISMS   9

Sampling methods, Detection & Enumeration of microbes in foods, Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens, Application of various techniques in food industry: SPC, MPN, spiral platter, DEFT, microcolony HGMF, DMC, Dye reduction, swab/swab-rinse method, impedance, microcalorimetry, flow cytometry, ATP measurement, PCR, Fluorescent antibody, RIA, ELISA.

UNIT IV   MICROORGANISMS USED IN FOOD FERMENTATION   9

Importance of microbes in food fermentation – Homo & hetero-fermentative bacteria, yeasts & fungi, Fermentation by Lactic acid bacteria, Alcoholic fermentation - Yeast fermentation - characteristics and strain selection, Fungal fermentation. Microbes associated with typical food fermentation-yoghurt, cheese, fermented milk, breads, idli, soy products, fermented vegetables and meats.

UNIT V   FOOD BORNE PATHOGENS, MICROBIAL EXAMINATION AND SAFETY   9

Food borne infections– food poisoning- botulism – salmonellosis - gastroenteritis, food borne pathogens – *Clostridium, Bacillus cereus, Staphylococcus aureus, Vibrio, Campylobacter, Yersinia* etc. Detection methods for *E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulinum & Salmonella, Listeria monocytogenes*. Food sanitation – indicators of food safety – coliform bacteria food processing plant sanitation – microbiological standards and guidelines – HACCP - microbial quality control and food laws.

Total: 45 HOURS

APPROVED BY BOS CHAIRMAN

Course Outcomes

On completion of the course the students are expected to

- Be able to understand and identify the various microbes associated with foods and food groups
- Be able to understand and identify the role of these microbes in food spoilage
- Understand the role of pathogens in food borne infections
- Understand the methods used to detect pathogens in foods
- Know the food processing and preservation involved in fermented products
- Understand the microbial safety measures involved in food processing sectors

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	1		2	1	1	3	2	2	1	2
2	3	1	2	2	2			2	1		2	1	2	2	1
3	2	2	1	3	1			2	1	2	3	2	1	1	
4	3	1		2	2		3		1		2	3	2		2
5	1	2		1	2		1		2	1	2	1	2		2
6	1	2	2		2		1		1		2	3	1		1

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS

1. James M. Jay, Martin J. Loessner and David A.Golden, Modern Food Microbiology, 7th Edition, Springer US, 2005.
2. W. C. Frazier, Dennis C. Westhoff and N.M. Vanitha, Food Microbiology, McGraw-Hill Book Co., 2013.
3. M.R. Adams and M.O. Moss, Food Microbiology, New Age International Publishers Ltd., New Delhi, 2008.

REFERENCES

1. K. Vijaya Ramesh, Food Microbiology, MJP Publishers, Chennai, 2007.
2. S.J. Forsythe, The Microbiology of Safe Food, Blackwell Science, 2010.

U19FTTL406L   FOOD MICROBIOLOGY LABORATORY   L   T   P   C
                                                                0   0   1   1

Course Objectives

- To enable students to understand the methods of isolating and characterizing various microbes associated with foods and food groups
- To enable students to understand and use various microbiological techniques for the study of foods
- To understand the methods used to detect pathogens in foods

LIST OF EXPERIMENTS

1. Safety in Microbiology laboratory. Microscopes – handling light microscopes
2. Micrometry – measurement of microorganisms
3. Food sampling techniques and preparation of sample homogenate for microbial analysis
4. Sterilization Techniques and equipment
5. Preparation of growth media for bacteria, yeast, moulds and actinobacteria
6. Isolation of microorganisms by serial dilution and plating technique
7. Purification and preservation of bacteria, yeasts and moulds
8. Identification of Yeasts, Mould and algae – morphological characterization
9. Enumeration of coliforms in water sample by MPN method
10. Detection of coliforms and E. coli in foods by Petri film technique
11. Isolation and identification of Staphylococcus aureus in foods
12. Production of single cell protein from Bacteria, Mushroom and Algae
13. Simple Staining Techniques – positive and negative staining
14. Differential staining - Gram Staining
15. Enumeration of Lactic acid bacteria from fermented foods
16. Microbial examination of blanched/pasteurized/sterilized foods

TOTAL: 45 HOURS

Course Outcomes

On completion of the course, the students will be able to

CO1: Complete understanding of isolation, characterization of various microbes associated with foods and food groups.

CO2: Familiarize with microbiological techniques for the study of foods.

CO3: Better understanding of methods to detect pathogens in foods.

APPROVED BY BOS CHAIRMAN

U19FTTH407   **FOOD PROCESS CALCULATIONS**   L   T   P   C
                                                              3   0   0   3

Course Objective:
- To perform calculations for basic operations in food processing.
- To understand the basic principles of psychometric in food process engineering.
- To apply the stoichiometric principles in food processing.
- To understand the fundamental calculations involved in food processing
- To impart the knowledge on energy balance on various unit operations of food engineering
- To understand the material balance and enthalpy changes on food engineering concepts

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	1		2	1	1	3	2	2	1	2
2	3	1	2	2	2			2	1		2	1	2	2	1
3	2	2	1	3	1			2	1	2	3	2	1	1	
4	3	1		2	2		3		1		2	3	2		2
5	1	2		1	2		1		2	1	2	1	2		2
6	1	2	2		2		1		1		2	3	1		1

3 - High, 2 - Medium, 1 – Low

UNIT I   UNITS AND DIMENSIONS, FUNDAMENTAL CALCULATIONS   9

Basic and derived units, unit conversions, use of model units in calculations, methods of expression, compositions of mixture and solutions. Ideal and real gas laws – gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II   PSYCHROMETRY   9

Humidity and Saturation: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, wet and dry bulb temperature, dew point - Humidity chart usage

UNIT III   MATERIAL BALANCE   9

Stoichiometric principles, material balance without chemical reaction- application of material balance to unit operations like distillation, evaporation, crystallization, drying and extraction.

UNIT IV   ENERGY BALANCE   9

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical reaction.

UNIT V   ENTHALPY CHANGES   9

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction Energy balances for systems without chemical reaction.

TOTAL: 45 HOURS

Course Outcomes
On successful completion of this course, the student will be able to
CO1: Enumerate the units and dimensions of various physical quantities.
CO2: Express the laws and theory of gases and vapour.
CO3: Calculate the material balance in food processing units.
CO4: Appraise the performance of processing units
CO5: Validate the energy balance and material balance in food processing operations.
CO6: Calculate the enthalpy changes on pressure and temperature involved in food engineering

APPROVED BY BOS CHAIRMAN

TEXT BOOKS

1. Gavhane K.A., Introduction to Process Calculations (Stoichiometry), 22nd Edition, NiraliPrakashan Publications, Pune, 2009.
2. Venkataramani V. and Anantharaman N., Process Calculations, Prentice Hall of India, New Delhi, 2003.
3. Bhatt B.L. and Vora S.M., Stoichiometry, 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2004.

REFERENCE BOOKS

1. Himmel blau D.M., Basic Principles and Calculations in Chemical Engineering, 6th Edition, Prentice Hall of India, New Delhi, 2003.
2. Narayanan K.V. and Lakshmi kutty B., Stoichiometry and Process Calculations, Prentice Hall of India, New Delhi, 2006.

APPROVED BY BOS CHAIRMAN

U19FTTL408T   **FOOD ANALYSIS**   L   T   P   C

                                                                    3   0   0   3

Course Objectives

- Instruct the sampling and proximate analysis of food substances
- Discuss the physical and chemical properties of lipids, protein and carbohydrate
- Understand the quality standards and adulterants of lipids, protein and carbohydrate
- Summarize the different spectroscopic techniques involved in food analysis
- Explain the various chromatographic methods employed in analysis of foods
- Outline the techniques on electrophoresis, refractometry and polarimetry in food analysis

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	3	1	2		2		2		2	3	1		3
2	1	2	2		3				1		2	1	2		2
3	2	3	1	2	1		3		2		1	2	3		1
4	2		2		3	1		2			2		2	2	
5	3	1	2		2		2		3		1	2	3	1	
6	1		2		1		2		1			1			3

3 - High, 2 - Medium, 1 – Low

UNIT I   SAMPLE PREPARATION AND PROXIMATE ANALYSIS   9

Introduction, Food regulations and standards, Sampling methods, Sample preparation for analysis. General methods of food analysis, Moisture in foods – Methods of determination, Ash content of foods – Wet & dry ashing, Microwave ashing, Sulphated ash, Water soluble ash, Acid insoluble ash in foods, Titratable acidity in foods, Dietary fiber and crude fiber analysis.

UNIT II   LIPIDS AND PROTEIN ANALYSIS   9

Lipid analysis in foods – methods, physical, chemical parameters, quality standards and adulterants. Protein analysis – colorimetric, spectrophotometric, total nitrogen and electrophoretic methods. Analysis of protein quality – Essential amino acid index (EAAI), Biological value (BV), Nutritional index (NI), Computed protein efficiency ratio (C-PER) and Protein digestibility corrected amino acid score (PDCAAS). Iso-electric focusing and precipitation. Measurement of functional properties of proteins. Amino acid analysis

UNIT III   CARBOHYDRATE ANALYSIS, REFRACTOMETRY AND POLARIMETRY   9

Carbohydrate analysis – Colorimetric, titrimetric, electrophoretic and difference methods. Starch – amylose determination. Pectin – Degree of methylation and acetylation.

Refractometry – Principles, types and instrumentation, Applications – Brix value and total soluble solids of fruit juices. Polarimetry- Principle and instrumentation, Saccharimeter, Applications in sugar industries. Immunoassay techniques and applications in food analysis.

UNIT IV   SPECTROSCOPIC TECHNIQUES   9

Spectrophotometry – principles, properties of light and matter. Analysis of food additives and food components, ultraviolet – visible absorption spectroscopy (UV-Vis), infra-red spectroscopy (IR), Atomic absorption spectroscopy (AAS), Inductively coupled plasma – optical emission spectroscopy (ICP-OES) in mineral elements and toxic metal analysis. Fluorescence spectroscopy in food analysis.

UNIT V   CHROMATOGRAPHIC TECHNIQUES   9

Common types of adulterants in food, General principle of chromatography – analysis of foods by paper, thin-layer and column chromatography. Gas chromatography (GC) – sample preparation, carrier gas, injection types, detectors and applications. High performance liquid chromatography (HPLC) – principle, types and instrumentation. Analysis of sweeteners and mycotoxins. Significance of MS detectors in GC and HPLC.

TOTAL: 45 HOURS

APPROVED BY BOS CHAIRMAN

Course Outcomes

At the end of the course, learners will be able to:

CO1: Test the proximate composition of the given food sample

CO2; Determine the physical, chemical and quality standards of lipids, proteins and carbohydrates

CO3: Investigate the adulterants in the given food commodities

CO4: Examine the composition of foods using spectroscopic methods

CO5: Analyze the food materials using chromatographic techniques

CO6:Perform the tests on food substances using the principles of electrophoresis, refractometry and polarimetry

TEXT BOOKS

1. Nielson, S. Suzanne. Food Analysis. Springer, 5th Edition, 2017.
2. Wood R, Foster L, Damant A and Key Pauline. Analytical Methods for Food Additives. CRC Woodhead Publishing 2004.
3. Pomeranz, Yeshajahu and Clifton E. Meloan "Food Analysis: Theory and Practice",3rd Edition, Springer, 2004.

REFERENCES

1. Nollet, Leo M.L. "Handbook of Food Analysis" 2nd Edition, Vol. 1-3. Marcel Dekker, 2004.
2. Hurst, Jeffrey W. "Methods of Analysis for Functional Foods and Nutraceuticals" 2nd Edition, CRC Press, 2008.

U19FTTL408L	FOOD ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- Determine the level of gluten content and alcoholic acidity
- Estimate the crude fiber content, BVO and extractives in tea and other food products
- Estimate the level of iodine content in iodized salt and fat content in foods
- Analyze the carbohydrates and milk fat content
- Measure the presence of adulterants in food products

List of Experiments

1. Determination of gluten
2. Determination of alcoholic acidity
3. Estimation of crude fiber content
4. Determination of total water soluble extractives in tea
5. Determination of presence of brominated vegetable oil in soft drinks
6. Estimation of iodine content in iodized salt
7. Estimation of fat content by Soxhlet method
8. Determination of carbohydrate by anthrone method
9. Estimation of fat content in milk by Gerbers method
10. Rapid detection of food adulteration

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, students can able to

CO1: Determine the gluten and alcoholic acidity of flour

CO2: Test and report the level of crude fiber, BVO in beverages and extractives in tea

CO3: Quantify the amount of iodine and fat content in various food products

CO4: Analyze the concentration of carbohydrates and milk fat in foods

CO5: determine the presence of adulterants in food materials and products

U19CCEX404	ENGINEERING EXPLORATION IV	L	T	P	C
		0	0	2	1

Course Objectives:
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

PRE-REQUISITES

NIL

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	3
9	Guided Project	
10	Final Project	9

Course Outcomes:

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 HOURS

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	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives
- To Develop students' ability to participate in the conversation.
- Develop an ability to use a number of key functional exponents with confidence and accuracy.
- To enable students to learn to interpret given information correctly, determine which mathematical model best describes the data, and apply the model correctly.
- To improve students' analytical and data interpretation skills.

Course Outcomes

At the end of the course, learners will be able to
- CO1. Able to participate in formal/informal conversations
- CO2. Speak in different contexts confidently and accurately
- CO3. Ability to interpret the given information correctly, determine which mathematical model best describes the data, and apply the model correctly.
- CO.4 To improve analytical and data interpretation skills.
- CO5. Apply the skills in speaking and writing.
- CO6: Apply the language skills in SUDOKU

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3				2	1		3	3		2		2
2		3	3				2	1		3	2		2		2
3		3	2				2	1		3	3		2		2
4		3	2				3	1		3	3		2		3
6									2	2		2			

3 - High, 2 - Medium, 1 – Low

UNIT I   **6**

Applied Language Skills: Self Introduction - Attending Interviews - Greeting - Starting a conversation- Social Conversation Skills

Quants: ANALOGY PATTERN RECOGNITION - Relating two objects - Problems on Number Analogy - Pattern completion.

UNIT II   **6**

Applied Language Skills: Asking and Giving Information - Apologizing and Excusing - Giving Instructions - Roleplays

Quants: CODING AND DECODING PATTERN RECOGNITION - Coding and decoding by letter shifting- Coding Letters of a Word-Coding and decoding in fictitious language

UNIT III   **6**

Applied Language Skills: Agreeing and disagreeing - Inviting, accepting and declining invitations - Negotiating Skills - Persuasive Skills - Debate

Quants: ANALYTICAL REASONING - Problems related to shapes – To find the missing numbers - Shape Construction - Cubes & Dices.

UNIT IV   **6**

Applied Language Skills: Expressing likes and dislikes - Complimenting - Mock Interviews - GD

Quants: Cognitive Problems & Puzzles - Find the next Image- Mirror Image- Water Image - Logical Puzzle

UNIT V   **6**

Applied Language Skills: Taking up certificate speaking test

Quants: VEDIC MATHEMATICS AND SUDOKU - Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots – Square roots - Logic- based Sudoku

TOTAL: 30 HOURS

APPROVED BY BOS CHAIRMAN

TEXTBOOK

1. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations The Newyork Times Paperback, 2018
2. by Kerry Patterson, Joseph Grenny, and Ron Mcmillan, Crucial Conversations Tools for Talking When Stakes Are High, McGraw Education, 2017
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand & Co Ltd., New Delhi.
4. Analytical Reasoning by M.K Pandey

REFERENCE

1. Interact English Lab Manual for Undergraduate Students. Orient BlackSwan: Hyderabad, 2016
2. Raman, Meenakshi, and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT", McGraw Hill Education; Eighth edition 2018.
4. Arun Sharma "How to Prepare for Logical Reasoning for the CAT", McGraw Hill Education; Eighth edition, 2018.
5. https://www.ted.com/talks
6. https://www.toastmasters.org/
7. https://www.edudose.com/reasoning/
8. https://testbook.com/aptitude-practice/

APPROVED BY BOS CHAIRMAN

U19ECTH505   **INSTRUMENTATION AND PROCESS CONTROL**   **L**   **T**   **P**   **C**
                             IN FOOD INDUSTRIES   **3**   **0**   **0**   **3**

Course Objective

- To provide fundamental knowledge on instruments and their applications in food processing
- To understand the function of instruments in food product development
- To understand the flow and temperature measurements involved in food industries
- To impart knowledge on the different types of sensors and transducers
- To understand the processing model and controller used in instrumentation techniques
- To understand the time and frequency response analysis

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3		1					2	2	1	3	
2	2	3	3	1		2					1	1	2	2	
3	2	2	1	2		1					1		3	1	
4	3	1	2	1		3					3	2	2	1	
5	3	2	2	3							2		3	2	
6		2	3			2					2	1		3	

3 - High, 2 - Medium, 1 – Low

UNIT I   **SENSORS AND TRANSDUCERS**   **9**

Introduction to measurement system – Resistive Transducers: Strain gauges - Resistance thermometers - Thermistors - Hotwire anemometer - Piezoresistive sensors - Humidity sensors – Inductive Transducers: LVDT – Induction potentiometer – Electromagnetic sensors – Capacitive Transducers: Variable air gap type – Variable permittivity type.

UNIT II   **FLOW AND TEMPERATURE MEASUREMEMNTS**   **9**

Level measurement: Float gauges – level switches – bubbler tube – Capacitance type – Ultrasonic type – Flow Measurement: Fixed and variable type flow meter – turbine flow meter – Electromagnetic flow meter – Temperature Measurement: RTD – Thermistor – Thermocouple – Dry and wet bulb psychrometers – Viscosity measurements.

UNIT III   **PROCESS MODEL AND CONTROLLER**   **9**

Introduction to open and closed loop system – Building blocks of mechanical and electrical systems – Single and Two tank system model – Controller Design: ON-OFF Control – P – Mode – I – Mode –D – Mode – P+I+D mode of controller – Digital Controller: Position and Velocity control.

UNIT IV   **TIME AND FREQUENCY RESPONSE ANALYSIS**   **9**

Time response – time domain specifications – Standard test inputs – Frequency response characteristics: Bode diagram – Nyquist plot and Stability analysis – Jury's stability test.

UNIT V   **INSTRUMENTATION AND SENSORS FOR THE FOOD INDUSTRY**   **9**

Optical Inspection Systems: Computer Vision system, Colour sorter. Food compositional analysis using NIR and FTNIR, Differential Scanning Calorimeter, XRD, XRF, SEM, TEM, water activity meter, textural analyser. Principles of measurement - Calibrations application in food industry. Practical considerations for implementing online measurements. Radiation thermometers: Principles of measurements and applications. Introduction to automation in food processing. Biosensors- e-nose, e-tongue, equipment – operating procedure and applications. Nitrogen analysers - instrumentation, operating procedure and application in analysis of foods

Course Outcomes

At the end of the course, learners will be able to:

CO1: Recall the parts of instrumentation and their working in food industry.

CO2: Analyze the basic principles of sensors and their applications.

CO3: Analyze the modelling of physical process, controller characteristics, selection of controller mode and control schemes.

CO4: Examine the concepts of system representation, time and frequency responses of systems.

C05: Design and develop instruments for food product development.

TEXT BOOKS

1. Erika Kress-Rogers and Christopher J. B. Brimelow, Instrumentation and sensors for the food industry, Wood head publishing, 2001.
2. Sharma, B.K, "Instrumental Methods of Chemical Analysis". Goel Publishing House, New Delhi 2004.
3. D. Patranabis, Sensors and Transducers, Prentice Hall India Pvt. Ltd, 2007.

REFERENCE BOOKS

1. E. O. Doeblin, Measurement Systems: Applications and Design, Tata McGraw-Hill Book Co., 2008.
2. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 2011.
3. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 2006.
4. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 30th reprint 2008.

U19FTTL509T **FUNDAMENTALS OF HEAT AND MASS TRANSFER IN FOOD TECHNOLOGY**

L	T	P	C
3	1	0	4

Course Objective

- To impart the knowledge of conduction heat transfer mechanisms.
- To provide the knowledge on the principles of convection and radiation.
- To study the performance of various types of heat exchangers.
- To learn about diffusion mass transfer.
- To impart the knowledge of fluid flow phenomena

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3		2	1		3	3		2		2	
2	3	3	3	2		2	1		3	2		2		2	
3	3	2	3	2		2	1		3	3		2	3	2	
4	3	2	3	2		3	1		3	3		2	3	3	
5	3	2				2	1		3	3		2	3	2	
6	3	2				3	1		3	3		2		3	

3 - High, 2 - Medium, 1 – Low

UNIT I **MODE OF HEAT TRANSFER FOR FOOD PROCESSING** **9**

Introduction to various modes of heat transfer, Fourier's law of heat conduction, effect of temperature on thermal conductivity, steady-state conduction, compound resistances in series, heat flow through a cylinder, and critical radius of insulation in pipes

UNIT II **HEAT TRANSFER COEFFICIENT AND PHASES** **9**

Heat flux, average temperature of fluid stream, overall heat transfer coefficient, LMTD, individual heat transfer coefficients, relationship between individual and overall heat transfer coefficients. Concept of heat transfer by convection, natural and forced convection, application of dimensional analysis for convection, heat transfer to fluids without phase change- phase change calculation for natural and forced convection in dairy and beverage industry

UNIT III **HEAT EXCHANGER EQUIPMENT FOR FOOD INDUSTRIES** **9**

Typical heat exchange equipment, counter current and parallel-current flows, enthalpy balances in: heat exchanges, total condensers. Double pipe exchanger, single-pass 1-1 exchanger, 1-2 parallel-counterflow exchanger, 2-4 exchanger, heat transfer coefficients in shell-and-tube exchanger, Calculation of number of tubes in heat exchangers in dairy industry

UNIT IV **MASS TRANSFER OPERATIONS FOR FOOD PROCESSING** **9**

Concept of thermal radiation, emissive power, black body radiation, Kirchoff's law, Stephen- Boltzman's law, energy exchange between; two large parallel planes, two parallel planes of different emissivity. Radiation intercepted by a shield, spheres or cylinders with spherical or cylindrical enclosures, radiation energy to a completely absorbing receiver

UNIT V **FOOD FLUID FLOW PHENOMENA** **9**

Nature of fluid flow – overall momentum balance – design equations for laminar and turbulent flow in pipes, friction factor, Darcy-Weisbach relation. – Differential equations of momentum transfer – Euler equation – Dimensional analysis in momentum transfer – Applications specific to food systems – Flow behaviour of ketchup, syrups, beverages, batter

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Understand and apply the principles of heat transfer phenomena for designing of heat transfer equipment

CO2: Understand and apply the principles of mass transfer phenomena for designing of mass transfer equipment's.

CO3: Understand and apply the principles of fluid flow phenomena in beverages industry.

CO4: Understand and apply the principles of heat transfer in dairy industries.

CO5: Understand and apply the principles of mass transfer operation in drying, extractor and distillation unit.

TEXT BOOKS:

1. Treybal, R.E. "Mass-Transfer Operations" 3rd Edition, McGraw-Hill, 1981.
2. Dutta, Binay, K. "Principles of Mass Transfer and Separation Process", PHI, 2007.
3. Nag, P.M. "Heat and Mass Transfer", 2nd Edition, Tata McGraw-Hill, 2007.
4. Geankoplis, C.J. "Transport Processes and Separation Process Principles (Includes unit Operations) 4th Edition, PHI, 2003.
5. Warren L. Mccabe, Julian C. Smith and peter Harriott, "Unit Operations of Chemical Engineering",6th Edn., McGraw Hill International Edition, NewYork 2001
6. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015

REFERENCE BOOKS:

1. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6thEdition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004
2. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, Mc Graw Hill, 2003.
3. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill, 1983.
4. Kumar, K.L., "Engineering Fluid Mechanics", 7th Edition. Eurasia Publishing, 1995.
5. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines". 5th Edition. Laxmi Publications, 1995.
6. Vasandani, V.P., "Hydraulic Machines - Theory and Design", Khanna Publishers, 1992.
7. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass transfer, New Age International Publishers, 2009

U19FTTL509L   HEAT AND MASS TRANSFER LABORATORY   L   T   P   C
                                                              0   0   2   1

Course Objectives

- To gain knowledge of conduction heat transfer mechanisms and on the principles of convection and radiation.
- To determine the performance of various types of heat exchangers.
- To conduct experiments on fluid flow phenomena.

Experiments

1. Determination of simple leaching.
2. Determination of atmospheric batch drying.
3. Determination of simple distillation.
4. Determination of open pan evaporation.
5. Determination of adsorption of oxalic acid from aqueous solution by activated charcoal.
6. Determination of counter current leaching.
7. Determination of cross current leaching.
8. Determination of heat transfer coefficient in a parallel flow heat exchanger
9. Determination of heat transfer coefficient in counter flow heat exchangers
10. Determination of effectiveness of heat transfer in a coiled type heat exchanger
11. Determination of liquid-liquid equilibrium.
12. Experiment of diffusivity measurement.
13. Study on mass transfer operation equipment

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Have knowledge on the basic principles of chemical engineering and its applications.

CO2: Be able to apply the skill of material balance and energy balance in unit operations and unit process.

CO3: To find time required for drying and to understand the operation of various types of drying equipment.

CO4: To understand the concept and operation of various types of gas-liquid contacts equipment's.

CO5: Recognize and work out in Heat Exchanger without phase change.

CO6: Estimate mass transfer coefficients for gas–liquid contacting systems and know about various analogies.

APPROVED BY BOS CHAIRMAN

U19FTTL510T   **FOOD PROCESS EQUIPMENT DESIGN**   **L   T   P   C**

                                                               3   0   0   3

Course Objective
- To enable the student to design and develop equipment's used in Food Processing operations.
- To identify and discuss critical design of typical processing equipment.
- To understand the relationship between process design and Safety

UNIT I   MATERIALS   9

Metals and non-metals, design of pressure vessels – cylindrical shell –internal and external pressure - under continued loadings. Numerical problem and design of pressure vessel.

UNIT II   STORAGE VESSELS   9

Design of storage vessels – Rectangular Tank without stiffeners –with stiffeners – shell design – Numerical problem and design.

UNIT III   REACTION VESSELS   9

Design of Reaction vessels – materials -classification – jackets-Design of vessel shell with half coil – Design of vessel shell with jacket – Numerical problem and design.

UNIT IV   HEAT EXCHANGERS   9

Design of Heat exchangers – types – materials – Design pressure and temperature- shell design – tubes – Numerical problem. Design of Equipment. Evaporator: Materials of concentration – types – design-consideration – Design of agitators – power requirements – Design based on Torque – critical speed.

UNIT V   DRYERS   9

Types - General considerations – Design of Tray dryer, Rotary Dryer – Material Balance, Thermal energy Requirements, electrical energy Requirements, Performance Indices

                                                               TOTAL: 45 HOURS

Course Outcomes
At the end of the course, learners will be able to:
CO1: Identify the factors that will affect the design of equipment's
CO2: Classify the variables based on various properties
CO3: Interpret the relation between various process variables
CO4: Select the critical variables for the design of equipment's
CO5: Develop a conceptual design model
CO6: Assess the validity of the conceptual model

TEXT BOOKS
1. Nag, P.M. "Heat and Mass Transfer", 2nd Edition, Tata McGraw-Hill, 2007.
2. Geankoplis, C.J. "Transport Processes and Separation Process Principles (Includes unit Operations) 4th Edition, PHI, 2003.

REFERENCES
1. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc. ISBN-0824743113, 2003
2. Joshi M.V, "Process Equipment Design", Macmillan India Ltd.,1985
3. Coulson,J.M. and Richardson,J.F. "Chemical Engineering" Butterworth-Heinemnn Elsevier, ISBN-0750644451, 2002

U19FTTL510L   **FOOD PROCESS EQUIPMENT DESIGN**   L   T   P   C
                          LABORATORY   0   0   2   1

Course Objectives
- To model parts and select sliding and rolling contact bearing
- To learn the application of CAD and assemble pressure vessels
- To design and assemble rigid flange couplings, flexible flange couplings
- To design and draft nuts, bolts, welded joints, and riveted joints
- To design and assemble knuckle, universal, socket, spigot, GIB and cotter joint

List of experiments
1. Introduction to Part and Assembly Modelling
2. Selection of Sliding and Rolling Contact Bearing
3. CAD and Assembly of Rigid Flange couplings
4. CAD and Assembly of Flexible Flange Couplings
5. CAD and Drafting of Nuts and Bolts
6. CAD and Drafting of Welded Joints
7. CAD and Assembly of Riveted Joints
8. 3D Assembly of Knuckle Joint
9. 3D Assembly of Universal Joint
10. 3D Assembly of Socket and Spigot Joint
11. 3D Assembly of GIB and Cotter Joint
12. CAD and Assembly of Pressure Vessels

TOTAL: 45 HOURS

Course Outcomes
At the end of the course, learners will be able to:
CO1: Model parts and sliding and rolling contact bearing
CO2: Apply the CAD to design pressure vessels
CO3: Design and assemble rigid flange couplings, flexible flange couplings
CO4: Design and draft nuts, bolts, welded joints and riveted joints
CO5: Design and assemble knuckle, universal, socket, spigot, GIB and Cotter joint

U19FTTL511T	LIVESTOCK AND FISH PROCESSING TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective

- Describe meat composition, structure, chemistry and microbial safety of meat
- Outline the various methods involved in the slaughtering processing of meat
- Summarize the variety of meat products, equipment employed and safety of meat processing plant
- Explain the overall processing of poultry meat and their products
- Review the processing of different marine based products
- Understand the different methods involved in carcass processing of meat

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	3	2	3		2		2		1	2	3	2	3
2	2	2	1	3	1		2		1		2	2	2	1	2
3		2	2	2	3		1		3		2	3	1	2	1
4	3	2	3	1	2						3	1		3	3
5		2	1	1	3		1		3			2	3		2
6	3		2		2		1				2		1	2	

3 - High, 2 - Medium, 1 – Low

UNIT I   **MEAT PROCESSING**   **9**

Types of meat and sources, structure and composition of meat, pre-slaughter care, handling and transportation of meat animals, ante-mortem examination, slaughtering and dressing of animals, post-mortem inspection of meat, biochemical changes in meat muscle, microbiology and spoilage factors, meat tenderization, meat quality, mechanically deboned meat, preservation of meat – chilling, freezing, curing, smoking, canning, dehydration and irradiation.

UNIT II   **POULTRY PROCESSING**   **9**

Chemical composition, nutritive value of poultry meat, handling and transportation, ante-mortem and post-mortem examination, dressing of poultry, preservation of poultry meat, primary processing unit operations in poultry processing

UNIT III   **FISH PROCESSING**   **9**

Classification of fisheries, composition, fishing techniques, handling of fishes, transportation, methods of preservation – chilling, freezing, smoking, salting, canning and drying, fish spoilage, bacteriology of fish, value added products

UNIT IV   **EGG PROCESSING**   **9**

Formation of egg, structure, composition and nutritive value of egg, preservation and maintenance – cleaning, oil treatment, cold storage, thermostabilization, immersion in liquids, preparation of egg powders, microbial spoilage of eggs, evaluation of egg quality, functional properties of egg

UNIT V   **MEAT PLANT HYGIENE AND SANITATION**   **9**

Modern abattoirs and its features, building, agents used in sanitation, properties and classification of sanitizing agents, organization of cleaning schedule, MFPO, hygienic design of processing equipment.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Enumerate the chemical composition, structure, color, flavor, and microbial safety of meat.

CO2: Demonstrate the slaughtering, carcass processing methods and equipment used for processing meat.

CO3: Apply the technological ideas in preparation of various types of meat-based products

CO4: Design the modern abattoir with the general requirements of safety and sanitation.

CO5: Evaluate the quality of poultry meat, meat products and egg products.

CO6: Classify the types of marine based foods and prepare value added products

TEXT BOOKS

1. Peter.P.Purslow, New aspects of meat quality, Woodhead Publishing, First edition, (ISBN: 9780081005934), 2017.
2. Rathnakumar and Kaavya, Textbook on fish processing technology, Narendra Publishing House, Delhi, First edition, (ISBN: 9789389996128), 2021.
3. Ashim Kumar Biswas and Prabhat Kumar Mandal, Textbook of poultry, egg and fish processing technology, Studium press, First edition, (ISBN: 9789387813182), 2018.

REFERENCE BOOKS

1. George.M.Hall, Fish Processing: Sustainability and new opportunities, Wiley-Blackwell Publishing, First edition, (ISBN: 9781405190473), 2010.
2. Sabel Guerrero and Hui YH. Handbook of Poultry Science Technology Volume-1. Wiley Publishing. First edition, 2010.
3. Sabel Guerrero and Hui YH. Handbook of Poultry Science Technology Volume-2. Wiley Publishing. First edition, 2010

U19FTTL511L	LIVESTOCK AND FISH PROCESSING	L	T	P	C
	LABORATORY	0	0	2	1

Course Objectives

- To practice the determination of pH, effectiveness of bleeding and water holding capacity of meat
- To measure the level of presence of free and expressible drips, glycogen in meat and sodium chloride in sea foods
- To study the drying characteristics of meat
- To evaluate the quality of external and internal quality of egg

List of experiments

1. Determination of pH in Meat
2. Determination of efficiency of bleeding
3. Determination of water holding capacity of meat
4. Measurement free and expressible drips
5. Detection of presence of glycogen in meat
6. Dehydration of meat
7. Estimation of sodium chloride in salted dry fish
8. Quality evaluation of egg external qualities
9. Quality evaluation of egg internal qualities
10. Quality evaluation of egg by candling

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Check the pH of meat, water holding capacity and efficiency of bleeding in meat

CO2: Measure free and expressible drip, level of glycogen in meat and sodium chloride of sea foods

CO3: Perform the dehydration of meat and other animal related products

CO4: Evaluate the quality of external and internal quality of egg

APPROVED BY BOS CHAIRMAN

U19FTTL512T **FOOD ADDITIVES** | L | T | P | C |

| | | | |
| 3 | 0 | 0 | 3 |

Course Objective

- To expose the students to the use of different chemical additives in foods during food processing
- To impart the knowledge on the various chemical additives involved in foods during food preservation
- To understand the daily intake levels of food additives
- To know the basic knowledge on acidity regulators and preservatives
- To understand the emulsifiers, stabilizers and thickeners used levels in food industrial sector
- To understand the level of adding colorants, antioxidants, flavours and fragrances used in food processing sector

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3		2	1		3	3		2		2	
2	3	3	3	2		2	1		3	2		2		2	3
3	3	2	3	2		2	1		3	3		2	3	2	3
4	3	2	3	2		3	1		3	3		2	3	3	3
5	3	2				2	1		3	3		2	3	2	
6	3	2				3	1		3	3		2		3	

3 - High, 2 - Medium, 1 – Low

UNIT I **INTRODUCTION** **9**

Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system, safety requirements of food additives, Acceptable daily intake, JECFA and Food Chemical Codex standards, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.

UNIT II **ACIDITY REGULATORS AND PRESERVATIVES** **9**

Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations.

UNIT III **EMULSIFIERS, STABILIZERS AND THICKENERS** **9**

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance, role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

UNIT IV **ANTIOXIDANTS AND ANTI-CAKING AGENTS** **9**

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anti-foaming and propellants, Anti-caking agents – definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application.

UNIT V   COLOR AND ARTIFICAL SWEETENERS   9

Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Artificial Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Understand the principles of chemical preservation of foods

CO2: Understand the role of different food additives in the processing of different foods

CO3: Know the regulations involved in controlling the safer use of additives in foods.

CO4: Understand the specific functions of various food additives to improving the shelf life

CO5: Understand the quality, texture and other physical and sensory additives in foods

CO6: Know the monitoring agencies involved to controlling the addition of food additives in various processing industries

TEXT BOOKS

1. Mahindru, S. N. "Food Additives- Characteristics Detection and Estimation", TATA McGraw Hill, 2000
   2. Wilson, R. "Ingredient Handbook Sweeteners", Blackwell, 2007

REFERENCE BOOKS

1. Emerton, V. "Food Colors", Blackwell, 2008
2. Peter A Williams and Glyn O Philips, "Gums and stabilizers for the Food Industry", RSC, 2006.
3. Branen, A. L. "Food Additives" 2nd Edition, CRC press, 2002.

U19CCLC503	CAREER ENHANCEMENT PROGRAM – III	L	T	P	C
		1	0	0	1

Course Objectives

- To develop making inferences and predictions based on comprehension of a text.
- To distinguish main idea(s) from supporting detail.
- To enhance problem-solving skills, to improve basic mathematical skills.
- To help the students who are preparing for any type of competitive examination.
- To draw conclusions and/or make decisions based on analysis and critique of quantitative information using proportional reasoning.

Course Outcomes

At the end of the course, learners will be able to

- CO1. Able to infer and predict content based on comprehension of a text
- CO2. Understand and distinguish main idea(s) from supporting detail
- CO3. Able to make decisions based on analysis and critique of quantitative information using proportional reasoning.
- CO4. Ability to enhance the problem-solving skills
- CO5: Evaluate the simple interest and compound interest
- CO6: Apply the language skills to build leadership skills.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3				2	1		3	3		2		2
2		3	3				2	1		3	2		2		2
3		3	2				2	1		3	3		2		2
4		3	2				3	1		3	3		2		3
5		3	2				2	1		3	3		2		2
6		3	2				3	1		3	3		2		3

3 - High, 2 - Medium, 1 – Low

UNIT I   **9**

Applied Language Skills: Reading for main ideas - Making Inferences- Identifying the theme - Writing different types of paragraphs - Para jumbles Quants: NUMBER SYSTEM – LCM & HCF – SIMPLIFICATION – SURDS & INDICES – CYCLICITY- EQUATIONS - Classification on Numbers - Power cycles and remainders - Concept of highest common factor – the concept of least common multiple - Divisibility Rule - Number of zeros in an expression - Problems on Surds and Indices - Concept of Unit digit - Simultaneous equations- Quadratic equations – In equation.

UNIT II   **9**

Applied Language Skills: Email etiquette - Email writing - Dangling modifiers - Writing different types of essays Quants: FUNDAMENTALS OF ALGEBRA - AVERAGES - Variables - Algebraic expressions - Substitution & evaluating expressions - Writing algebraic expressions - PERCENTAGES – the concept of percentage values through additions - fraction to the percentage conversion table.

UNIT III   **9**

Applied Language Skills: Resume and cover letter writing - Visumes - Practice- Preparation of Resumes for placements Quants: RATIOS AND PROPORTION- comparison of ratios - proportions - relation among the quantities more than two – variation. - PARTNERSHIP - MIXTURES AND ALLEGATIONS - PROBLEM ON AGES - Definition - Allegation rule - mean value (cost price) of the mixture - Problems on ages and Problems related to ratios

APPROVED BY BOS CHAIRMAN

UNIT IV   **9**

Applied Language Skills: Technical Reports - Structure of the report - Critical Reasoning- Employee motivation, Satisfaction and commitment - Work Ethics Quants: Problem on Ages - Profit & Loss - Discount - Simple Interest & Compound Interest - Data Interpretation.

UNIT V   **9**

Applied Language Skills: Organizational Communication - Leadership skills- Stress management - Self Appraisal - Taking up a Reading test Quants: Time, Speed & Distance - Problems on Trains - Boats & Streams - Data Sufficiency.

<div align="right">

TOTAL: 45 HOURS

</div>

TEXTBOOKS
1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.
2. The Slight Edge, Jeff Olsen, Momentum Media, 2013
3. Aggarwal, R.S. "Quantitative Aptitude", Revised Edition 2016, Reprint 2018, S.Chand & Co Ltd., New Delhi
4. Arihant Publications," Quantitative Aptitude Quantum CAT ", Sarvesh Kumar Verma

REFERENCES
1. Interact English Lab Manual for Undergraduate Students. Orient Black Swan: Hyderabad, 2016
2. Raman, Meenakshi, and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT ", McGraw Hill Education; Eighth edition 2018
4. Pearson Publication, "A Complete Manual for the CAT", 2018
5. https://learnenglish.britishcouncil.org/general-english/magazine
6. https://blog.lingoda.com/en/10-news-sites-to-practice-your-english-reading-skills
7. https://testbook.com/aptitude-practice/
8. http://www.allindiaexams.in/online-test/online-aptitude-test/all

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APPROVED BY BOS CHAIRMAN

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U19CCEX505	**ENGINEERING EXPLORATION V**	**L T P C**	

	L	**T**	**P**	**C**
	1	0	2	1

COURSE OBJECTIVES

- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab
- To inculcate ethics and sustainability perspectives and enable students to work in a team

PRE-REQUISITES

NIL

CONTENTS

S No	Topics	No of Hours
1	Introduction to Engineering	3
2	Platform based development	12
3	Mechanisms	9
4	Requirements	3
5	Design	
6	Ethics	6
7	Sustainability	
8	Project Management Principles	
9	Guided Project	3
10	Final Project	9

COURSE OUTCOMES

CO1. Understand the role of an engineer as a problem solver

CO2. Apply multi-disciplinary principles and build systems using engineering design process and tools

CO3. Analyze engineering solutions from ethical and sustainability perspectives

CO4. Use basics of engineering project management skills while doing projects

CO5. Communicate, Collaborate and work as a team

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2		2	2	2	2	1	1	1	1
2	3	3	3	3		2		2	2	2	2	1	2	2	2
3	3	3	3	3		2		2	2	2	2	1	2	2	2
4	3	3	3	3		2		2	2	2	2	1	2	2	2
5	3	3	3	3		2		2	2	2	2	1	2	2	2

3 – HIGH; 2 –MEDIUM; 1 –LOW

GUIDELINES

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 3-4 students.
3. Groups can select to work on specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model at the end of semester.
6. The progress of the course is evaluated based on class performance and final demonstration of prototype.

Total:45 Hours

APPROVED BY BOS CHAIRMAN

U19FTTL613T	BAKING AND CONFECTIONERY TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective

To enable the students to understand about

- To gain knowledge of the machinery and processes involved in baking.
- To familiarize with the commercial methods of baking bread and recent advances in bakery industry.
- To learn microbiological aspects of bakery products, sanitation and hygiene in baking industries.
- To know the manufacturing of different confectionery products.
- To understand the rheological properties of dough
- To understand the various methods involved in the cake manufacturing and its by-products

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3		2		2		1	3	2	2	3
2	3	2	2	3	2		2		3		2	3	2	1	3
3	2	1	1	2	2		3		2		1	3	3	2	2
4	3	2		1	3		1		2		2	3	3	1	3
5	3	3	2	1	1		2		2			3	2	2	2
6	3	2	2	2	3		3		3		2	3	3	3	3

3 - High, 2 - Medium, 1 – Low

UNIT I   INTRODUCTION TO BAKING   9

Classification of bakery products. Bakery ingredients and their functions - flour, yeast, sugar, fat, egg, water, salt, colouring agents, flavouring agents, milk, milk powder, emulsifiers, leaveners, antioxidants and improvers.

UNIT II   BAKERY EQUIPMENTS   9

Introduction to utensils an equipment's used in bakery industry with their - Bulk handling of ingredients - Dough mixers, Dividers, rounding, sheeting and laminating - Fermentation enclosures and brew equipment, Ovens and Slicers, Rheology of dough - Farinograph, Amylograph, Alveograph, and Extensograph.

UNIT III   BREAD BAKING   9

Bread making methods- Straight dough/bulk fermentation, Sponge and dough, Activated dough development, Chorleywood bread process, No time process. Advantages and disadvantages of various methods of bread - making. Characteristics of good bread - Internal and external characters. Bread defects/faults and remedies. Spoilage of bread - Causes, detection and prevention

UNIT IV   BAKERY PRODUCTS   9

Cake - types of cakes - role of ingredients - cake mixing methods – preparation. Biscuits - role of ingredients. Types of biscuit dough - Developed dough, soft dough, semi-sweet and enzyme modified dough - and its importance. Cookies – classification - quality control -faults and causes. Miscellaneous bakery products production - Wafers, crackers, puff pastry, chemically leavened bakery products

UNIT V   CONFECTIONERY PRODUCTS   9

Definition - importance of sugar confectionery – manufacturing methods of soft- and hard-boiled candy – ingredients and prevention of re-crystallization and stickiness. Manufacturing methods, ingredients, formulation and quality control of Caramel, Toffee, marshmallow and Fudge. Aerated confectionery - methods of aeration and manufacturing processes.

TOTAL: 45 HOURS

APPROVED BY BOS CHAIRMAN

Course Outcomes

At the end of the course, learners will be able to:

CO1: Have a better understanding of process technology of bakery and confectionery products

CO2: Learn completely of the use of sanitation and safety practices in bakery and confectionery production.

CO3: Acquire entrepreneurship skills required for starting a baking and confectionery unit.

CO4: Prepare a new product and formulations according to the demand of the product in baking

CO5: Design and model user friendly and easy handling baking processing equipment's.

CO6: Understand the easy handling confectionery processing equipment's.

TEXT BOOKS

1. Matz, Samuel A., "Bakery Technology and Engineering", III Edition, Chapman & Hall, London.
2. Cauvain, Stanley P, and Young, Linda S., "Technology of Bread Making", II Edition Aspen publication. Maryland, 1999

REFERENCES

1. Edwards W.P. "Science of bakery products", RSC, UK,2007
2. Samuel A. Matz., "Equipment for Bakers", Pan Tech International Publication. 1988.
3. E.B.Jackson. Sugar Confectionery manufacture, II edition, Blackie Academic and professional, Glasgow, 1995.

U19FTTL613L	BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

- To acquaint with the preparation of various bakery products and perform quality analysis for the same

List of experiments

1. Dough characteristics – determination of gluten and dough rising capacity of yeast.
2. Experiment on leavening action of baking powder, sodium bicarbonate and ammonium bicarbonate.
3. Preparation of Bun and bread rolls
4. Preparation of plain and fancy cakes – baking, cost estimation, sensory and texture analysis
5. Preparation, cost estimation and sensory analysis of different types of biscuits and cookies
6. Preparation of aerated traditional gram based confectionery – Mysore Pak
7. Preparation and cost estimation of chikki.
8. Preparation of toffee
9. Preparation of marshmallow
10. Preparation of soft boiled and hard boiled candies
11. Preparation, cost estimation and texture analysis of crackers and wafers.
12. Preparation of caramel and use in different products
13. Preparation of chocolates
14. Floor plan layout for a bakery and confectionery unit
15. Visit to bakery and confectionery units

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Identify and explain baking terms, ingredients, equipment and tools

CO2: Learn different types of bakery products and their quality

CO3: Acquire baking skills and understand the scope of baking industry

APPROVED BY BOS CHAIRMAN

U19FTTL614T   **FRUITS AND VEGETABLE PROCESSING**   L   T   P   C
                     TECHNOLOGY   3   0   0   3

Course Objective

To enable the students to understand about

- To enable the students to appreciate the application of scientific principles in the processing of fruits.
- To understand the basic knowledge on principles and applications of processing technology of vegetables
- To impart technical knowledge of about how to develop products and preservation
- To understand the methods of dehydration
- To understand the physiological developments of fruits and vegetables
- To impart the knowledge of post and pre-harvest storage techniques in fruits and vegetables

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1		2	1		3	3		2	2	2
2	3	3	3		3		2	1		3	2		2	1	2
3	2	3	2	3			2	1		3	3		2	2	2
4	3	3	2	2			3	1		3	3		2	3	3
5	1	3	3	2	3		2	1		3	2		2	1	2
6	2	3	2		1		2	1		3	3		2	3	2

3 - High, 2 - Medium, 1 – Low

UNIT I   PHYSIOLOGICAL DEVELOPMENT   9

Classification of fruits and vegetables. General structure, composition and nutritional aspects. Physiological Development - maturation, ripening, senescence. Harvesting – methods and tools. Deterioration factors - physical, chemical and biological. Changes during deterioration. Methods of reducing deterioration.

UNIT II   POST HARVEST HANDLING AND STORAGE OF FRUITS AND VEGETABLES   9

Handling – methods, transportation – methods, Pre-cooling methods and evaporative cooling. Preparatory operations and related equipment's - washing, cleaning, grading, peeling and blanching methods. Pre-treatments for storage – Irradiation, Waxing. Storage of fruit and vegetables - under ambient conditions, low temperature storage. Freezing - types - methods. Controlled and modified atmosphere storage - concepts and methods, minimal processing

UNIT III   PROCESSING AND PRESERVATION OF FRUITS AND VEGETABLES   9

Importance and scope of fruit and vegetables preservation. Nutritive value, nutraceutical properties – Definition and need for value addition. Methods of fruit and vegetable preservation - Processing using sugar – Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt – Brining - Preparation of pickles, chutney and sauces, ketchup. Machineries involved in processing of fruits and vegetables products. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

UNIT IV   DRYING AND DEHYDRATION   9

Drying and dehydration -Types of driers - Solar, cabinet, fluidized bed drier, spouted bed drier, heat pump drier, vacuum drier and freeze drier. Preparation of product changes during drying and dehydration. Problems related to storage of dried and dehydrated products

UNIT V   CANNING AND BOTTLING   9

Canning - principles, types of cans– preparation of canned products - packing of canned products - spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

APPROVED BY BOS CHAIRMAN

Course Outcomes

At the end of the course, learners will be able to:

CO1: Gain a better understanding of the concepts of physiological characteristics of fruits and vegetables.

CO2: Have a good insight about fruit losses during storage and ways to prevent it.

CO3: Obtain a thorough knowledge and understandings of the specific processing technologies used for different foods.

CO4: Prepare a variety of dried and dehydrated products using various types of dryers

CO5: Perform a canning and bottling operations for the prepared and formulated products according to the requirement

CO6: Understanding the specific processing technologies involved in the various product derived from fruits and vegetables

TEXT BOOKS

1. Hui Y.H., Handbook of fruits and fruit processing, 1st Edition, Blackwell Publishing, USA, 2006.
2. Thompson A.K., Fruits and Vegetable - Harvesting, Handling and Storage, Blackwell Publishing, USA, 2003.
3. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
4. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.

REFERENCES

1. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
2. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.

U19FTTL614L   **FRUITS AND VEGETABLE PROCESSING**   **L   T   P   C**
                                LABORATORY   **0   0   2   1**

Course Objectives

To develop skills related to

- Preservation and analytical techniques in fruit and vegetable products
- Use of various techniques and additives for fruit and vegetable processing and quality analysis

List of experiments

1. Preparation and analysis of Marmalade/ fruit preserve
2. Preparation and analysis of Jam/Jelly
3. Preparation of ready to serve (RTS) from Mango/ Orange/Grapes
4. Canning of fruits/peas
5. Preparation of malt based drink
6. Preparation and preservation of tomato puree and sauce/ketchup
7. Osmotic dehydration of fruits
8. Preparation of fruit preserve – Fig/Aonla/Rose
9. Preparation and analysis of fruit leather
10. Effect of blanching on vegetables
11. Minimal processing of fruits and vegetables
12. Sauerkraut fermentation
13. Osmotic dehydration of vegetables
14. Experiment on sensory evaluation of food products
15. Visit to fruit and vegetable processing industry

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Experience the preparation and analysis of different fruit and vegetable product

CO2: Analyze the prepared products according to the standard testing procedures

CO3: conduct shelf-life and improve and prefer the best packaging and storage conditions of the products

U19FTTH608   **REFRIGERATION AND COLD CHAIN**   L   T   P   C
                            MANAGEMENT   3   0   0   3

Course Objective

To enable the students to understand about

- To understand the underlying principles of operation in different refrigeration and its components
- To understand the basic principles and applications involved in cold storage systems
- To provide knowledge on design aspects of cold storage systems
- To understand the refrigerants and different cycling systems
- To impart of knowledge of shelf life storage of food processing and packaging products
- To analyse and classify the refrigerating conditions for food processing products and it applications

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO
1	3	3	3	3			2	1		3	3		2	3	2
2	2	3	3	2			2	1		3	2		2	2	2
3	2	3	2	3			2	1		3	3		2	2	2
4	3	3	2	2			3	1		3	3		2	3	3
5	2	3	3	1			2	1		3	2		2	2	2
6	1	3	2	2			2	1		3	3		2	1	2

3 - High, 2 - Medium, 1 – Low

UNIT I   REFRIGERATION PRINCIPLES   9

Refrigeration – principles- refrigeration effect – coefficient of performance – units of refrigeration – simple vapor compression cycle – T-S diagram – p-h chart – application of refrigeration.

UNIT II   VAPOUR COMPRESSION REFRIGERATION AND COMPONENTS   9

Vapour compression system – refrigeration components – compressor and condenser – types, construction and working – expansion device and evaporators – types, construction and working

UNIT III   REFRIGERANTS AND VAPOUR ABSORPTION CYCLE   9

Refrigerants – properties – classification – comparison and advantages – chloroform carbon (CFC) refrigerants – effect on environmental pollution – alternate refrigerants – vapour absorption cycle – theoretical – deviation in practice – Electrolux refrigerator – construction and principles

UNIT IV   SHELF-LIFE OF FOOD PRODUCTS   9

Defining overall shelf-life, remaining shelf life in the context of chilled and frozen foods; - deterioration modes of food items; models of quality deterioration – kinetic model; shelf-life model; Q10/q10 model; TTT model for the remaining shelf-life; general procedure for shelf-life testing – the 11 steps procedure Storage of frozen foods: - basic design requirements of storage to uphold the shelf-life-size, insulation, entry – exit position, palletization, proper disk-space for air circulation, automatic door – closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers etc.

UNIT V   COLD CHAIN   9

Canning - principles, types of cans– preparation of canned products - packing of canned products - spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

                                          TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Understand the basic units, conversions, principle and application of refrigeration

CO2: Demonstrate the types, construction and working of various components of vapor compression refrigeration system

CO3: Outline the classification of refrigerants and types of vapor absorption system

CO4: Assess the shelf life of foods and the requirements of cold storage construction

CO5: Discuss the various components of cold chain management

CO6: Understand the working principles of refrigeration and frozen technology

TEXT BOOKS

1. Andrew DA, Carl HT, Alfred FB (2004). Modern Refrigeration and Air Conditioning. The Goodheart – Willcox Company, Inc. 9th Edition. [ISBN: 678910-04-0807]

2. Hundy GF, Trott AR, Welch TC (2008). Refrigeration and Air Conditioning. Butterworth – Heinemann Publication. 4th Edition. [ISBN: 978-0750685191]

3. Khurmi RS and Gupta JK (2019). A Textbook of Refrigeration and Air Conditioning. S.Chand Publications. 1st Edition. [ISBN: 978-8121927819]

4. Trott AR and Welch T (2000). Refrigeration and Air Conditioning. Butterworth – Heinemann Publication. 3rd Edition. [ISBN: 07506-4219x]

5. Arora CP (2009). Refrigeration and Air Conditioning. Tata Mc Graw Hill Publishing company Limited. 3rd Edition. [ISBN: 978-0-07-008390-5]

REFERENCES

1. Chris.J.Kennedy (2000). Managing Frozen Foods. CRC-Woodhead- Publishing Limited. 1st Edition. [ISBN: 1855734125]

2. Brown. M (2008). Chilled Foods: A Comprehensive Guide. Woodhead Publishing Limited. 3rd Edition. [ISBN: 978-1-4200-8775-8]

3. Bin Fu and Labuza TP (1997). Shelf-life Testing: procedures and Prediction Methods. Chapmann and Hall Publications. [ISBN: 9780412070419]

U19CCLC604	CAREER ENHANCEMENT PROGRAM – IV	L	T	P	C
		1	0	0	1

Course Objectives
- To develop strategies to improve students' writing skills.
- To learn about different types of documents used for business writing.
- To understand the relevance & need of quantitative methods for making business decisions.
- To demonstrate a sound knowledge of the fundamentals of statistics and statistical techniques.
- To apply quantitative methods to solve a variety of decision-making problems.

Course Outcomes
- CO1: Able to participate in formal/informal conversations.
- CO2: Speak in different contexts confidently and accurately.
- CO3: Ability to understand relevance & need of quantitative methods for making business decisions
- CO4: Able to solve real-time problems statistically.
- CO5: Apply height and distance concepts in application skills.
- CO6: Study the AP, GP & HP data Interpretations.

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3				2	1		3	3		2		2
2		3	3				2	1		3	2		2		2
3		3	2				2	1		3	3		2		2
4		3	2				3	1		3	3		2		3
5		3	3				2	1		3	2		2		2
6		3	2				2	1		3	3		2		2

3 - High, 2 - Medium, 1 – Low

UNIT I 9

Applied Language Skills: Active Vocabulary - Writing Personal experiences - Process Description
Quants: Time & Work - Pipes & Cisterns - using fractions, percentages & negative work.

UNIT II 9

Applied Language Skills: Writing notices, business letters, and reports(Minutes & Projects)
Quants: Permutation & Combination - Probability - arrangements - selections - chances.

UNIT III 9

Applied Language Skills: Resume and cover letter writing – Self Introduction Video Upload - Practice-Description of the company for which the interview is scheduled.
Quants: Geometry - Mensuration Concepts - Area & Volume - 2D & 3D.

UNIT IV 9

Applied Language Skills: Book review- Article writing - Writing emails - Letter to the editor
Quants: Trigonometry - Basic concepts - Heights & Distance and its applications.

UNIT V 9

Applied Language Skills: Taking up certificate tests in reading
Quants: Sequence & Series - Progressions - AP, GP & HP - Data Interpretations - Data Sufficiency.

TOTAL: 45 HOURS

TEXTBOOKS

1. Chris Anderson, TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations The Newyork Times Paperback, 2018
2. by Kerry Patterson, Joseph Grenny, and Ron Mcmillan, Crucial Conversations Tools for Talking When Stakes Are High, McGraw Education, 2017
3. Quantitative Aptitude for Competitive Examinations - R S Aggarwal
4. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal

REFERENCES

1. Interact English Lab Manual for Undergraduate Students. Orient Black Swan: Hyderabad, 2016
2. Raman, Meenakshi, and Sangeetha Sharma. Professional Communication. Oxford University Press: Oxford, 2014.
3. Arun Sharma "How to Prepare for Quantitative Aptitude for the CAT ", McGraw Hill Education; Eighth edition 2018
4. Pearson Publication, "A Complete Manual for the CAT", 2018
5. https://www.ted.com/talks
6. https://www.toastmasters.org/
7. https://testbook.com/aptitude-practice/
8. http://www.allindiaexams.in/online-test/online-
9. aptitude-test/all

U19FTPR601   **MINI PROJECT**   L T P C
                                                                     0 0 3 2

Course Objectives

To enable learners of Engineering and Technology develop their basic communication skills in English.

To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.

To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.

To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix   3 –HIGH; 2-MEDIUM; 1-LOW

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

U19FTTH709 PROFESSIONAL ETHICS IN ENGINEERING **L T P C**

3 0 0 3

Course Objective:

- To enable the students to create an awareness on Engineering Ethics and Human Values, and to appreciate the rights of others.
- To understand moral and social values in engineering
- To understand engineering experimentation and laws.
- To know the basic knowledge on stress management and ethical theories
- To understand the safety, responsibilities and rights in engineering ethics
- To understand the global issues and responsibility in human values and engineering ethics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3	3		3	2	3		3	3		2	3	2
2	2	3	3	2		2	2	2		3	2		2	2	2
3	2		2	3		3	2	3		3	3		2	2	2
4	3	2	2	2		2	3	1		3	3		2	3	3
5	2		3	1		2	2	2		3	2		2	2	2
6	1		2	2		1	2	1		3	3		2	1	2

 3 - High, 2 - Medium, 1 – Low

UNIT I HUMAN VALUES **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of ‗Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) Discrimination

UNIT V GLOBAL ISSUES **9**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: **45 HOURS**

APPROVED BY BOS CHAIRMAN

Course Outcome:

CO1: Understand completion of the course, the student should be able to apply ethics in society.

CO2: Discuss theethical issues related to engineering and realize the responsibilities.

CO3: Discuss the ethical issues related to engineering and rights in the society.

CO4: Understand the safety, responsibilities and rights

CO5: Analyse and discussed the global issues in engineering ethics

CO6: Understand the ethical issues and ethical theories in professional engineering

TEXT BOOKS:

1.Mike W. Martin and Roland Schinzinger, ‒Ethics in Engineering‖, Tata McGraw Hill, NewDelhi, 2003.

2.Govindarajan M, Natarajan S, Senthil Kumar V. S, ‒Engineering Ethics‖, Prentice Hall of India, New Delhi, 2004.

REFERENCES:

R1:Charles B. Fleddermann, ‒Engineering Ethics‖, Pearson Prentice Hall, New Jersey, 2004.

R2: Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ‒Engineering Ethics – Concepts and Cases‖, Cengage Learning, 2009.

R3:John R Boatright, ‒Ethics and the Conduct of Business‖, Pearson Education, New Delhi, 2003

R4:Edmund G Seebauer and Robert L Barry, ‒Fundamentals of Ethics for Scientists and Engineers‖, Oxford University Press, Oxford, 2001.

R5:Laura P. Hartman and Joe Desjardins, ‒Business Ethics: Decision Making for Personal Integrity and Social Responsibility‖ Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

R6:World Community Service Centre, ‗ Value Education', Vethathiri publications, Erode, 2011.

Web sources:

www.onlineethics.org

www.nspe.org

www.globalethics.org

www.ethics.org

U19FTTH710   **FOOD PACKAGING**   **L T P C**
                                                                     3 0 0 3

Course Objective:

1.To develop the knowledge of students in the area of packaging of different foods and the related technology used.

2.To appreciate the application of scientific principles in the packaging of foods.

3.To understand the basics techniques involved in food packaging.

4.To understand the packaging media' s, testing and transport packages

5.To impart the basic knowledge on general classification, types and its applications of food packages

6.To analyse and classify the food packaging design and environmental issues

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3		2	3				2	3	2	2	3
2	2	3	2	1		1	2				2	2	3	2	1
3	3	1	2	1		1	3				3	1	2	2	2
4	2	1	3	1		2	2				2	3	2	3	3
5	1	3	2	2		3	2				1	1	2	3	2
6	3	2	2	2		1	3				2	3	1	1	2

3 - High, 2 - Medium, 1 – Low

UNIT I   BASICS OF PACKAGING   9

Packaging –Concepts, definition, Significance, classification. Packaging – Development, Retail/Unit; Packaging of foods –fresh and processed

UNIT II   PACKAGING MEDIA & MATERIALS   9

Primary packaging media – Properties and application, Paper boards, metals, plastics, wood and plywood, glass, flexible materials Labels, caps and closures and adhesives, inks and lacquers, cushioning materials, reinforcements; Testing & evaluation of packaging media – retail packs & transport packages

UNIT III   PACKAGING SYSTEMS AND METHODS   9

Vacuum packaging, gas flush packaging, CAP & MAP, aseptic & retort packaging, box in box. Food products-General classification and packaging types, varieties and trends Storage handling and distribution of packages-including pallets & containers; Modern methods of packaging.

UNIT IV   PACKAGING DESIGN   9

Food marketing and role of packaging; Packaging aesthetic and graphic design;Packaging – Laws and regulations

UNIT V   ENVIRONMENTAL ISSUES IN PACKAGING   9

Coding and marking including bar coding and Environmental, ecological & Economicissues, recycling and waste disposal.

                                                                     TOTAL: 45HOURS

Course Outcomes:

        To gain knowledge on

- The different types of materials and media used for packaging foods.
- Discussed the different Hazards associated with packaging materials and laws.
- Understanding the toxicity associated with packaging materials and laws
- Understanding the monitoring agencies involved food safety
- Analyse and characterize the various regulations and labelling of foods
- Methods of packaging, shelf life and food factors affecting packaging

TEXT BOOKS:

1. Robertson, G.L. ─Food Packaging: Principles and Practice‖. 2nd
   Edition. Taylor &Francis,2006.
2. Han, Jung H. ─Innovations in Food Packaging‖. Elsevier, 2005.
3. Ahvenainen, Raija. ─Novel Food Packaging Techniques‖. Wood Head Publishing, 2003.
4. Mathlouthi, M. ─Food packaging and Preservation‖. Aspen Publications, 1999.

APPROVED BY BOS CHAIRMAN

U19FTTH711   FOOD SAFETY, QUALITY AND REGULATION   LT P C
                                                          3 0 0 3

Course Objectives:
- To characterize different type of food hazards and biological in theindustry and food service establishments
- To understand the physiochemical hazards in food industrial sectors
- To impart the basic knowledge on food security and regulations
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		2	3		2	3		2		2	3	2	2	3
2	2			1		1			1		2		3	2	1
3	1			1		1			3		3		2		2
4	2			1		2	2						2		3
5	1			2		3	2		2		1	1	2		2
6	1		2	2		1	3		1		2	3	1	1	2

        3 - High, 2 - Medium, 1 – Low

UNIT I   9
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II   9
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III   9
Critical Quality control point in different stages of production including raw materials and processing materials: Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system tomonitor food safety, risk communication

UNIT IV   9
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V   9
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

                                                    TOTAL: 45 HOURS

Course Outcome:

CO1: Thorough Knowledge of food hazards, physical, chemical and biological in the industryand food service establishments

CO2: Understand the various hazards involved in food processing sector

CO3: Understand the various physiochemical hazards involved in food packaging sector

CO4: Analyse and classified the international agencies and laws involved in safety and security

CO5: Understand the different norms, policy involved in various regulatory techniques

CO6: Awareness on regulatory and statutory bodies in India and the world

REFERENCES:

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc.,New York 1979
4. Microbiological safety of Food by Hobbs BC, 1973
5. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2000

APPROVED BY BOS CHAIRMAN

U19FTPR702　　　　　　　**PROJECT PHASE I**　　　　　| **L** | **T** | **P** | **C** |
| **0** | **0** | **4** | **2** |

Course Objectives:
- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes:

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix　　3- HIGH; 2-MEDIUM; 1 -LOW

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

APPROVED BY BOS CHAIRMAN

U19FTPR803   **PROJECT PHASE II**

L	T	P	C
0	0	12	6

Course Objectives

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

Course Outcomes

At the end of the course, learners will be able to

CO1 identify technically and economically feasible problems of social relevance

CO2 plan and build the project team with assigned responsibilities

CO3 identify and survey the relevant literature for getting exposed to related solutions

CO4 analyse, design and develop adaptable and reusable solutions of minimal complexity by using modern tools

CO5 implement and test solutions to trace against the user requirements

CO6 deploy and support the solutions for better manageability and provide scope of improvability

Course Articulation Matrix   **3-HIGH; 2-MEDIUM; 1-LOW**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1		2	2	2	2	2	2	1	1	1	1
2	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
3	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
5	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2
6	3	3	3	3	2	2	2	2	2	2	2	1	2	2	2

The students are assigned project work related to product / process development, solution to the technical problems in industry and current research at national and international level. The student is required to submit a report at the end of semester based on the findings. The evaluation is made as per the Regulations of University.

PROFESSIONAL ELECTIVES

U19FTPE001	SPICES, PLANTATION AND TUBER CROPS TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective

To enable the students to understand about

- Coffee and its processing techniques, instant coffee, and quality grading.
- Different types of tea and its manufacturing techniques, instant tea, quality parameters of tea.
- Cocoa and its processing, chocolate manufacturing technology Processing and chemistry of major spices.
- Processing and chemistry of minor spices, tuber and medicinal crops.

UNIT I   PROCESSING OF SPICES   9

Spices production and importance – stage of harvesting and harvesting methods - processing of major and minor spices – pepper, cardamom, chilli, turmeric, ginger, garlic, cumin, fenugreek, clove, nutmeg, vanilla – equipment's used - value addition of spices.

UNIT II   PROCESSING OF COFFEE, TEA AND COCOA   9

Types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process - Grading of tea – packaging. Coffee – Occurrence – chemical constituents – fermentation of coffee beans – Process flow sheet for the manufacture of coffee powder. Instant coffee – manufacturing and packaging. Processing of cocoa – methods, process and equipment – value added products – grading and types – packaging and storage.

UNIT III   PROCESSING OF COCONUT, ARECANUT AND CASHEW   9

Processing of plantation crops – production and importance – processing of coconut, arecanut, cashew– harvesting and stages of harvest – drying, cleaning and grading – production of value-added products – packaging and storage of produces.

UNIT IV   PROCESSING OF TUBER CROPS   9

Chemical composition and processing of tuber crops - tapioca, potato, sweet potato, yam, sugar beet – equipment's used – processed products. Starch and sago production - by-products - applications and processing

UNIT V   PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES   9

Cleaning and grading of spices –packaging and storage of spices- grading specifications- Agmark, ASTA, ESA specifications –- method involved in the manufacture of oleoresins and essential oils – quality analysis of spices and their derivatives.

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Define the different unit operations and its equipment involved in coffee, tea and cocoa processing

CO2: Gain knowledge in processing of plantation crops and spices and also its value-added products.

CO3: Outline ways in which quality loss can be minimized during preparation and processing

CO4: Develop value added products from plantation products and spices

CO5: Demonstrate appropriate technique for the extraction of spice oil and oleoresin with quality standards

CO6: Acquire confidence to get placement of cereals and spices industry with minimum post-harvest losses.

TEXT BOOKS

1. Pandey, P. H, "Post-Harvest Engineering of Horticultural Crops through Objectives". Saroj Prakasam, Allahabad 2002.
2. Pruthi, J.S, "Major Spices of India – Crop Management and Post-Harvest Technology". Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi. PP. 514, (1998).

REFERENCES

1. ASTA, "Official analytical methods of the American Spice Trade Association", Fourth Edition 1997.
2. Purseglove, J.W., and S.R.J.Robbins, "Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series", Longman, London, 1: 605. (1981)
3. Pruthi, J.S, "Spices and Condiments: Chemistry, Microbiology and Technology". First Edition. Academic Press Inc., New York, USA 1980.

APPROVED BY BOS CHAIRMAN

U19FTPE002 **FAT AND OIL PROCESSING TECHNOLOGY** **L T P C**
                                                                  3 0 0 3

Course Objectives:

CO1: To understand the physical and chemical properties of fats and oils.

CO2: To study the extraction and refining processes of various oils and fats.

CO3: To learn the packaging, quality standards of fats and oils.

Course Outcomes:

The students will be able to

1. Enumerate the importance of fats and oils.

2. Describe the manufacturing process of oils and fats.

3. Apply knowledge on manufacture of designer fats.

4. Appraise the quality attributes of oils and fats.

5. Design suitable packaging materials.

6. Invent methods for industrial applications of oils and fats.

UNIT 1: Physical and Chemical Properties   **8**

Fats and oils – formation – functions of oil in human body - fatty acids – double bonds and their position in oil – Geneva type classification - sources of vegetable oils – production status-oil content – coconut , palm, peanut , rice bran, sesame, mustard and sunflower seeds oil – physical and chemical properties of fats and oils - chemical reactions of oil – hydrolysis – hydrogenation, oxidation and polymerization.

UNIT 2: Extraction Methods   **9**

Oil extraction methods –mechanical expression – ghani , power ghani, rotary, hydraulic press, screw press, expellers, filter press - principle of operation and maintenance-solvent extraction process – steps involved, batch food process technology and continuous-continuous solvent extraction process for rice bran, soy bean and sunflower-oil extraction process for groundnut and cotton seed-production of special oils – palm oil, virgin coconut oil – extraction process.

UNIT 3: Refining of Oils   **9**

Refining of oils – objectives – characterization - degumming – Zeneath process – deacidification process – continuous acid refining-bleaching of oil –decolourising agents-deodorization and winterization processes-Hydrogenation of Fats – Vanaspati and Margarine – Ghee and butter

UNIT 4: Packaging of Edible Oils   **9**

Packaging of edible oils – requirements – types – tinplate, semi rigid, glass, Polyethylene Terephthalate, Poly Vinyl Chloride, flexible pouches – packaging for Vanaspati and ghee changes during storage of oil – rancidity – causes – atmospheric oxidation and enzyme action – free fatty acid – colour-non edible oils – castor oil, linseed oil, vegetable waxes – production and processing.

UNIT 5: Industrial Applications and Quality Standards   **9**

Industrial applications of fats and oils – quality regulations - manufacture of soap, candle, paints and varnishes - ISI and AGMARK standards – site selection for oil extraction plant- safety aspects- HACCP standards in oil industries.

                                              Total: 45 HOURS

Text books

1. Harry Lawson, "Food oils and Fats - Technology, Utilization and Nutrition", CBS Publishers and Distributors, New Delhi, 1997.

2. Gunstone F.D., "Oils and Fats in Food Industry", Blackwell Publishing, United Kingdom, ISBN – 13: 9781405181212, 2008.

Reference book

1. **Gunstone** F.D., "Vegetable Oils in Food Technology: Composition, Properties and Uses", 2nd Edition, Wiley - Blackwell Publishing Ltd., ISBN 9781444332681, 2011.

APPROVED BY BOS CHAIRMAN

U19FTPE003   **ECONOMICS AND PLANT LAYOUT DESIGN**   **L T P C**

3 0 0 3

Course Objectives:

CO1: To enable the students understand various concepts of economics of food plant.

CO2: To understand the processes involved in layout design.

CO3: To understand the development and design consideration and cost estimation in food industry.

Course Outcomes:

CO1: To gain knowledge on the various factors involved in setting up a Food Processing Industry.

CO2: To understand the process of food plant layout design.

CO3: To apply their knowledge to design projects for setting up a Food Processing Industry.

CO4: To analyse the problems involved in deciding the level of manufacture of a food product

CO5: To evaluate the options involved and decide on the right choice based on the economics of the system

CO6: To develop own industry or plan turn-key projects based on the request from customers

Unit I - FOOD PROCESS DESIGN DEVELOPMENT: **9**

Technical feasibility survey of Food Industry, process development, Food Process flow sheets – Hygienic food process design - equipment design and specifications – Computed-aided process design – Principles of spread-sheet aided process design (Basic concepts only)

Unit II - PLANT LAYOUT: **9**

Marketability of the product, availability of technology, raw materials, equipments, human resources, land and utilities, site characteristics, waste disposal, Government regulations and other legal restrictions, community factors and other factors affecting investment and production costs. Plant Layout based on process and product. Richard Muther's Simple Systematic Plant Layout.

Unit III - PROJECT EVALUATION AND COST ESTIMATION: **9**

Capital investments – fixed capital investments including land, building, equipments and utilities, installation costs (including equipments, instrumentation, piping, electrical installation and other utilities), working capital investments. Methods of Cost estimation – Cost Indices.

Unit IV - PRODUCT COST AND PLANT OVERHEADS: **9**

Manufacturing costs – Direct production costs(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.). – Process Profitability - Application to a Food Processing plant e.g. Tomato processing - Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc. Depreciation, Amortization and methods of determining the same. Introduction to Food Safety Management System.

Unit V - PROFITABILITY ANALYSIS: **9**

Return on original investment, interest rate of return, accounting for uncertainty and variations and future developments. Cash flow diagram and its importance - Optimization techniques – Linear and Dynamics programming, Optimization strategies.

Total: 45 HOURS

Text Book

1. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, ISBN-007-124044-6, 2004 .

Reference Books

1. Rudd D F and Watson C C, Strategy of Process Engineering, John Wiley & Sons Inc, ISBN-978-0471744559, 2013

2. Maroulis Z.B. and Saravacos G.D. Food Process Design, Marcel Dekker Inc. ISBN-0824743113, 2003.

3. Towler G and Sinnott R.K. Chemical Engineering design principles, practice and Economics of Plant and Process. 2nd Edition. Elsevier, ISBN-9780080966595, 2012

U19FTPE 004   **RECENT TRENDS IN FOOD PROCESSING**   **L T P C**
                                                                           3 0 0 3

Course Objectives:

CO1: To develop the knowledge of students in the area of emerging or alternative technologies applied to food processing.

CO2: To understand the advantages and disadvantages over existing technologies.

CO3: To understand the high pressure processing of foods and its by-products

CO4: To impart the basic knowledge of pulse electric field processing techniques in food processing

CO5: To understand the novel methods involved in non-thermal processing

CO6: To understand the hurdle technology in thermal and non – thermal processing

UNIT I: HIGH PRESSURE PROCESSING OF FOODS   **9**

Introduction, principles, use of high pressure to improve food safety and stability. Effects of high pressure on food quality, Applications of high pressure. HPP of Salads/Ready Meals – effects on microorganisms, enzyme activity, texture and nutrients.

UNIT II: PULSED ELECTRIC FIELD PROCESSING   **9**

Mechanism of action, PEF treatment systems; PEF processing of liquid foods and beverages. High intensity electric field pulses on solid foods. Non thermal methods- its applications - Application of light pulses in sterilization of food sand packaging materials.

UNIT III: NOVEL METHOD   **9**

Non thermal processing by radio frequency electric fields; Ultrasound as a food preservation tool; Freeze drying - Food irradiation - advantages and applications. – Super critical fluid extraction – Aseptic processing in foods - extrusion cooking – equipment.

UNIT IV: HURDLE TECHNOLOGY   **9**

Basics of hurdle technology – Mechanism, Application to foods - Newer Chemical and Biochemical hurdles-organic acids – Plant derived antimicrobials – Antimicrobial enzymes– bacteriocins – chitin / chitosan (only one representative example for each group of chemical and biochemical hurdle).

UNIT V : INNOVATION IN FOOD REFRIGERATION   **9**

Vacuum cooling of foods; High pressure freezing; Freeze drying (lyophilisation) – Theory – Equipment - Effect on foods – Freeze concentration – Theory - Equipment

                                                                   TOTAL: **45 HOURS**

Course Outcomes:

On completion of the course the students are expected to

CO1: To understand and identify the different processing technologies and their application.

CO2: To Understand the application of scientific principles in the processing technologies specific to the materials.

CO3: To understand the novel methods involved in food refrigeration

CO4: To familiarize the hurdle technology in processing sectors of thermal and non-thermal processing

CO5: To develop the innovation of refrigerated design and process

TEXT BOOKS:

1. Da-Wen Sun,"Emerging Technologies for Food Processing", Academic press/ Elsiever, London, UK,2005.

REFERENCES:

1. Leistner L. and Gould G. Hurdle Technologies – Combination treatments for food stability safety and quality, Kluwer Academics / Plenum Publishers, New York (2002).

2. Da –Wen Sun, "Thermal Food Processing: New Technologies and Quality Issues, 2nd Edition, CRC Press/Taylor & Francis, Boca Raton, Florida,USA, 2012.

3. Gustavo V.Barbosa-Canovas, Maria S.Tapia and M.Pilar Cano, "Novel Food Processing Technologies". CRC Press, 2004.

U19FTPE005　　　　**FOOD NANOTECHNOLOGY**　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

Course Objective:

CO1: To learn about basis of nanomaterial science, types and applications

CO2: To understand the classifications of nanostructed food materials and particles

CO3: To analyse the general methods involved in the preparation of nano food samples

CO4: To understand the nanoforms, nanometal and nanoclay functional properties and applications

CO5: To impart the basic knowledge on the various characterization techniques involved in nao-food technology

CO6: To understand the concepts and applications of nanofood based products and its by-products

UNIT- I: INTRODUCTION　　　　　　　　　　　　　　　　　　　　**9**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowiresultra- thinfilms- multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT – II: GENERAL METHODS OF PREPARATION　　　　　　　**9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT – III: NANOMATERIALS　　　　　　　　　　　　　　　　　**9**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis (arcgrowth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications- Quantum wires, Quantum dots-preparation, properties and applications.

UNIT- IV: CHARACTERIZATION TECHNIQUES　　　　　　　　**9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT – V: APPLICATIONS　　　　　　　　　　　　　　　　　　**9**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

　　　　　　　　　　　　　　　　　　　　　　　　TOTAL: **45 HOURS**

COURSE OUTCOMES:

CO1: To familiarize about the science of nanomaterials

CO2: To demonstrate the preparation of nanomaterials

CO3: To develop knowledge in characteristic nanomaterial

CO4: To understand the concepts of nanomaterials involved in food processing sectors

CO5: To understand the basic knowledge of nanomaterials involved in food packaging sectors

CO6: To develop nanobased food capsules for astronauts

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Propertiesand Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition,Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

U19FTPE006   FOOD EXTRUSION TECHNOLOGY   L T P C
3 0 0 3

Course Objectives:

CO1: Students should be able to understand, demonstrate skills and apply knowledge in food extrusion processing.

CO2: Students should be able to formulate, process and understand quality parameters of the varied combinations of ingredients in food extruder

UNIT -1 : Food Extrusion: 9

Definition, introduction to extruders, principles and types, Uses of extruders in the food industry, Pre-conditioning of raw materials used in extrusion process, Extruder Selection, Design, and Operation for Different Food Applications

UNIT -2 : Single and Twin Screw Extruder: 9

Single screw extruder: Principle of working, Net Flow, Operations, manufacturing of pasta and vermicelli

Twin screw extruder: Counter rotating and co-rotating twin screw extruder, Process characteristics of the twin screw extruder, Rheological Properties of Materials During the Extrusion Process, Advantages of Twin Screw Extruder

UNIT – 3 : Effect of extrusion on food products: 9

Chemical and nutritional changes in food during extrusion, factors affecting extrusion, Net Flow, Packaging materials for extruded product. Classification of Breakfast cereals: Raw materials, process and quality testing for Ready to eat breakfast cereals.

UNIT – 4: Texturized vegetable protein: 9

Definition, Manufacturing process and quality parameters of TVP

UNIT -5 : Recent Advances in extrusion technology: 9

Carbon dioxide or Nitrogen assisted extrusion technology, Extrusion in confectionary technology, Non-thermal Extrusion of Protein Products

Course Outcome:

CO-1   Understanding basic fundamentals, design considerations, processing of different extruded products and selection of food extrusion equipments

CO-2   Understanding suitability of raw materials, preconditioning, process variables and extruder types for extrusion.

CO-3   Understanding chemical and nutritional changes occurring in extrusion process and packaging requirement of extruded products

CO-4   Knowing recent trends and future aspects of food extrusion

CO5   Understand the extrusion process, rheological behaviour and product quality

Reference Books:

1   Extruded foods by S. Matza Publisher Springer
2   Technology of Extrusion Cooking by N.D. Frame Publisher Springer
3   Extruders in Food Application by Riaz M.N. Publisher CRC Press
4   Extrusion of Foods by J.M. Harper Publisher CRC Press
5   Advances in Food Extrusion Technology by Maskan and Altan Publisher CRC Press

U19FTPE007   **SPECIALITY FOODS**   **L T P C**
                                                    3 0 0 3

Course Objective:

CO1: To introduce students to various therapeutic and speciality foods.

UNIT I   **9**

Need and scope of specialty foods: Specialty food based on ease in preparation cost health benefits; Functional foods, Convenience food, Health care and medical benefits, Nutritional status, Low cost foods.

UNIT II   **9**

A. Specialty foods based on sources; Cereals and millets, Legumes and pulses, Fruits and vegetables, Animal food sources, By product based, Non-conventional foods.

B. Specialty foods based on process; Innovative process technology, Food additives basis, Bioactive components, Novel neutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods. Specialty foods based on growing condition - organic, inorganic farming.

UNIT III   9

Specialty food based on genetics; genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification. Proprietary foods. Supplementary foods.

UNIT IV   9

Therapeutic foods ; Modification of diets in disorders, feeding purposes Disease oriented of different organs ex: digestive tract, liver, cardiovascular system, kidney , metabolic disorders, allergy, endocrine disorders.

UNIT –V   9

Specific consumer oriented foods; Defence persons, Space / astronaut, High altitude mountain climbers, Disaster situation – crises, care, maintenance.

                                             TOTAL: 45 HOURS

Course Outcome:

CO1: To Understand the benefits of various speciality foods

CO2: To impart the knowledge of need and scope of speciality foods

CO3: To understand the speciality foods based on various sources

CO4: To develop more innovated products

CO5: To understand speciality food based on genomics

CO6: To analyse and classify the therapeutic foods

TEXT BOOK:

1. Yanyun Zhao "Specialty Foods: Processing Technology, Quality, and Safety", CRC Press, 2012

REFERENCES:

1. Steve Taylor, "Advances in Food and Nutrition Research", Volume 49, Elsevier Inc. , 2005

2. Parvinder S. Bali, "Food Production Operation", Oxford University, 2014

U19FTPE008	ENGINEERING PROPERTIES OF FOOD	L	T	P	C
	MATERIALS	3	0	0	3

Course Objective

To enable the students to understand about

- The physical properties of food materials
- The rheology of food and use of viscometer and texture analyzer in food industry.
- Thermal properties of food commodities
- The aerodynamic and hydrodynamic properties of foods
- The electrical properties of food and its applications in food engineering

UNIT I   PHYSICAL PROPERTIES OF FOODS   9

Methods of estimation of Shape, Size, volume, density, porosity and surface area, sphericity, roundness specific gravity. Frictional properties-coefficient of friction, Storage and flow pattern of agricultural crops..

UNIT II   RHEOLOGICAL PROPERTIES OF FOODS   9

Definition – classification – Newton's law of viscosity – momentum-diffusivity-kinematic viscosity – viscous fluids – Newtonian and Non Newtonian fluids- Viscosity Measurements-Viscometers of different types and their applications-Texture measuring instruments-Hardness and brittleness of Food materials.

UNIT III   THERMAL PROPERTIES OF FOODS   9

Definitions   of Heat   capacity, specific   heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient, Measurement of thermal properties like specific heat, enthalpy, conductivity and diffusivity, DTA, TGA, DSC

UNIT IV   AERODYNAMIC AND HYDRODYNAMIC PROPERTIES OF FOODS   9

Drag and lift coefficient, terminal velocity and their application in the handling and separation of food materials. Water activity- measurement-vapor pressure method –freezing point depression method- Effect of temperature, and pressure on water activity-moisture sorption isotherms- models-Henderson, PET and GAB models.

UNIT V   ELECTRICAL PROPERTIES OF FOODS   9

Dielectric properties-dielectric constants, Dielectric Measurements-Ionic Interaction-Dipolar rotation. Effect of moisture, temperature and pressure on dielectric properties. Microwave heating-Infrared   and Ohmic heating, Irradiation

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Estimate the physical properties of food materials

CO2: Report the frictional properties and storage of agricultural crops

CO3: Compare and contrast the Newtonian and non-Newtonian fluids

CO4: Express the overall thermal properties of food materials

CO5: Measure the aero- and hydrodynamic characteristics and the application of frictional properties in grain handling, processing and conveying.

CO6: Demonstrate the dielectric and radiation heating properties of foods

TEXT BOOKS

1. Serpil Sahin and Servet Gulum Sumnu. Physical Properties of Foods. Springer. USA, 2007.
2. Nuri N. Mohsenin. Thermal Properties of Food & Agricultural materials", Gordon and Reach science publishers, 1990.

REFERENCES

1. Lewis M.J. Physical properties of foods and food processing systems. Woodhead publishing Cambridge, UK, 2006.
2. Shafiur Rehman. Food Properties Hand book. CRC press inc. New York, 2nd Edition, 2009.

U19FTPE009   **FOOD MATERIAL SCIENCE**   **L T P C**
                                                                    3 0 0 3

Course Objectives:

CO1: To enable students understand the physical chemistry and kinetics of food systems

CO2: To make the students understand the interaction of food constituents in maintaining the texture and structure of a food

Course Outcomes:

Students would be able

1. To understand the importance of glass transitions and its relation to stability

2. To understand the theory of gelling and its effect on texture of foods

3. To develop new products which are nutritional and cost effective

4. To understand the relationship between structure and properties of foods

5. To predict their behavior during storage

6. To develop cheaper sources of raw materials for a product

UNIT 1: GLASS TRANSITIONS IN FOODS   **9**

Basics of theory of glass transitions – crystalline and amorphous polymers, - difference, Glass transition temperature, crystallite melting point, Crystal melting point – Key elements of the food polymer science approach –Fringed micelle structural model – the dynamics map – Effect of molecular weight on Tg – Plasticizer – water as a plasticizer - Crystallisation – gelation mechanism – Polymer crystallization kinetics theory - Importance in food systems

UNIT 2: PHYSICAL CHEMISTRY OF FOOD GELS AND GELLING   **9**

Nature of the gel state – Mechanism of gel formation in food systems – point cross linking, extended junction zone formation, particle association and spinodal decomposition – gel network types. Basic Theories of gelation – Flory –Stockmayer theory – percolation theory, diffusion –limited aggregation model – mechanical properties of cured gels – Small deformation studies – differentiation between strong and weak gels - frequency dependence, strain dependence and temperature dependence of visco-elastic modulus – Large deformation studies – failure envelopes

UNIT 3: GENERATION OF ENGINEERED GEL STRUCTURES   **9**

Foods as composite materials – Characteristics of composite materials – solid foams and sponges – Fibrous structures – Reinforcement by solid particles and fibers – Mixed dairy gels – filled dairy gels – Cellular structures of fruits and vegetables

UNIT 4 : STRUCTURES & PROPERTIES OF FOOD EMULSIONS   **9**

General aspects of emulsions – Types of food emulsions – Oil in water, water in oil, water in oil in water- Measurement of particle size and size distributions in emulsions - Factors affecting stability of emulsions – Structures of adsorbed layers on the surfaces of emulsion droplets -Importance of interfacial layer – Protein stabilized emulsions and foams

UNIT 5: STRUCTURE –PROPERTY RELATIONSHIPS IN FOODS   **9**

Structure property relationships in foods- axes for food properties-texture-to axes quantifying texture in solid foods-food micro structure-structure property relationships in food structure-formation of structure in processed foods-modeling-simple models for viscoelastic foods-structure property relationships in nutrition and health-gastronomical engineering

                                                TOTAL – 45 HOURS

Text Books

1. Aguilera JM and LillfordP.J., "Food Materials Science - Principles And Practice", Springer, USA. e-ISBN No. 978-0-387-71947-4. 2008.

2. Schwartzberg H.G., and Hartel R.W., "Physical Chemistry of Foods", Marcel Dekker Inc., New York, ISBN No. 0824786939, 1992.

                                                APPROVED BY BOS CHAIRMAN

Reference Books

1. Bhandari B. and Roos Y.J. "Food Materials Science And Engineering", Wiley Blackwell Publishing Ltd., UK. ISBN 978-1-4051-9922-3. 2012

2. Friberg S., Larsson K. and Sjoblom S. "Food Emulsions" Marcel Dekker Inc., Fourth Edition, ISBN No. 0824746961, 2004.

3. Damodaran S., Parkin K. and Fennema O.R.,"Fennema's Food Chemistry", CRC Press, ISBN No. 0849392721, 9780849392726, 2008.

4. Belitz H-D., Grosch W.and Schieberle P., "Food Chemistry"- Springer Verlag, Berlin Heidelberg, Germany, III Revised Edition, ISBN No. 3540408177, 2004.

APPROVED BY BOS CHAIRMAN

U19FTPE010	BEVERAGE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objective

To enable the students to understand about

- The classification of beverages.
- Knowledge and skills of processing techniques.
- The quality aspects of beverages
- Understand the ingredients used in beverages
- Understand the colorants and preservatives used for beverages
- Knowledge the basic concepts of sanitation and quality control

UNIT I   INGREDIENTS IN BEVERAGES   9

Beverage-definition--ingredients- water, quality evaluation and raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nano-emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT II   CARBONATED BEVERAGES   9

Procedures- ingredients- preparation of Syrup making, carbonation of soft drinks. Carbonation equipments and machineries- -containers and closures. low-calorie and dry beverages; isotonic and sports drinks; Fruit based carbonated beverages, carbonated water

UNIT III   NON-CARBONATED BEVERAGES   9

Beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy based beverages, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages. bottled. Water; mineral water, natural spring water, flavored water.

UNIT IV   ALCOHOLIC BEVERAGES   9

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipment's used for brewing and distillation, wine and related beverages, distilled spirits

UNIT V   SANITATION AND QUALITY CONTROL   9

Quality control, Filling-inspection and quality controls-sanitation and hygiene in beverage industry-Quality of water used in beverages threshold limits of ingredients. FSSAI, EFSA and FDA regulations

TOTAL: 45 HOURS

Course Outcomes

At the end of the course, learners will be able to:

CO1: Capable of formulating beverages using various ingredients.

CO2: Demonstrate various unit operations involved in the food beverage manufacturing

CO3: Understand the various production techniques in beverages.

CO4: Evaluate the quality parameters of all beverages

CO5: Familiarize with food laws and regulations of beverages

CO6: Understand the quality control and sanitation techniques

TEXT BOOKS

1. L.Jagan Mohan Rao and K.Ramalakshmi (2011)"Recent trend in Soft beverages", Woodhead Publishing India Pvt Ltd.
2. Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.

REFERENCES

1.Hui, Yiu H., et al., eds. (2004) Handbook of food and beverage fermentation technology. Vol. 134. CRC Press.

2.Mitchell, Alan J. (199) "Formulation and Production Carbonated Soft Drinks". Springer Science & Business Media, Woodroof, Jasper Guy, and G. Frank Phillips. (1981) Beverages: carbonated and noncarbonated. AVI Pub. Co.

APPROVED BY BOS CHAIRMAN

U19FTPE011   BIOLOGY AND CHEMISTRY OF FOOD FLAVOURS   L T P C
                                                                    3 0 0 3

Course Objectives:
• To understand the flavour compounds involved in development of flavor
• To understand the analytical techniques involved in flavor analysis

UNIT I INTRODUCTION   9
Problems in flavour research – classification of food flavours; chemical compounds responsible for flavour.

UNIT II FLAVOUR COMPOUNDS   9
Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.

UNIT III THE CHEMICAL SENSES   9
Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

UNIT IV FLAVOUR ANALYSIS   9
Subjective versus Objective methods of analysis; psychophysics and sensory evaluation and its types, ENOSE, ETONGUE; Instrumental analysis; sample handling and artifacts; data handling

UNIT V TEACHING FLAVOUR CONCEPTS   9
Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench

                                                          TOTAL: 45 HOURS

Course Outcomes:
CO1:Better understanding and knowledge of contribution of different compounds for the development of flavour.
CO2: Understand the Analytical techniques involved in flavor analysis.
CO3: Understand the biological concepts in food flavours
CO4: Knowledge on flavour analysis and techniques
CO5: Develop more innovative flavour compound's on natural resources'
CO6: Understanding the concepts of sensory analysis using tongue and nose

TEXT BOOKS:
1. Fisher, Carolyn and Thomas R. Scott. "Food Flavours: Biology and Chemistry". The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. " Flavor Chemistry and Technology". CBS Publishers, 1996.
3. Reineccius, Gary. "Flavor Chemistry and Technology". II Edition, Taylor & Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. "Flavor Chemistry of Ethnic Foods". Kluwer Academic / Plenum, 1999.
5. Ashurst, Philip R. "Food Flavorings". III Edition, Aspen Publications, 1999.

REFERENCES:
1. Hofmann, Thomas. "Challenges in Taste Chemistry and Biology". American Chemical Society Publications, 2004.
2. Charalambous, G. "Food Flavors: Generation, Analysis and Process Influence". Elsevier, 1995.

U19FTPE012 CREATIVITY, INNOVATION AND NEW FOOD PRODUCT DEVELOPMENT

L T P C

3 0 0 3

Course Objective:

CO1: To study the various issues related to Creativity, Innovation and New Product Development.

UNIT I INTRODUCTION 9

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION 9

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

UNIT III NEW PRODUCT PLANNING 9

Design of proto type - testing - quality standards - marketing research - introducing new products

UNIT IV NEW PRODUCT DEVELOPMENT 9

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

UNIT V MODEL PREPARATION & EVALUATION 9

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

TOTAL: 45 HOURS

Course Outcome:

CO1: To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

CO2: To understand the ideas and purpose of project

CO3: To develop new product planning and development

CO4: To understand technological innovation factors

CO5: To understand patent rights and laws

CO6: To develop model preparation and evaluation techniques

TEXT BOOKS:

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.

2. Watton, Harry B. "New Product Planning", Prentice Hall Inc., 1992.

REFERENCES:

1. Nystrom, Harry "Creativity and Innovation", John Wiley & Sons, 1979.

2. Khandwalla, N. – "Fourth Eye (Excellence through Creativity) - Wheeler Publishing", 1992.

3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

U19FTPE013   FOOD GREEN CHEMISTRY AND TECHNOLOGY   L T P C
                                                                    3 0 0 3

Course Objectives:

CO1: To enable the students understand the basics of Green chemistry

CO2 : To know the importance of eco-friendly methods of manufacture of various products

Course Outcomes:

On completion of the course, the students will be able to

1. Understand the basics of Green chemistry

2. Gain knowledge on sustainability and life cycle assessment

3. Gain knowledge and apply solid acid catalysts in synthesis

4. Choose an eco-friendly and cost-effective method of manufacture of products

5. Improve existing methods for improved efficiency and economics

6. Develop novel methods for improved efficiency and economics

UNIT 1 INTRODUCTION AND PRINCIPLES OF GREEN CHEMISTRY   9

Chemistry Past, Present and Future – The Costs of Waste – The Greening of Chemistry – Green chemistry and Industry – Waste Minimization and Atom Economy – Atom Economy, Some Inherently atom economic reactions and Some Inherently Atom Uneconomic reaction - Reduction of energy requirement – Some energy efficiency improvements and Alternate energy sources - Chemistry of Atmosphere – Chemistry of oceans

UNIT 2: SUSTAINABILITY AND LIFE CYCLE ASSESSMENT (LCA)   9

Concept of Sustainability – Green Chemistry and Sustainabilitys parameters – LCA methodology – Methodological Framework – Applications of LCA – Product Oriented LCA – Process Oriented LCA

UNIT 3: SOLID ACID CATALYSTS   9

Concepts in Acidity and Solid Acid Catalysts – Industrial Applications of Solid Acid Catalysts – Zeolite based Solid Acid Catalyst, HeteroPolyacid based Solid Acid Catalyst, Sulphated Zirconia, Ion Exchange Resins and Acidic Pillared Clays - Recent Developments in Catalytic Materials and processes

UNIT 4: MICELLE TEMPLATED SILICAS AS CATALYSTS   9

Structured Mesoporous Materials – Synthesis of Micelle Templated Materials, Post Functionalisation of Micelle Templed Materials and Direct Preparation of Organically Modified Micelle Templated Silicas - Catalytic Applications

UNIT5: BIOCATALYSIS AND GREEN CATALYSTS FOR INDUSTRY   9

Chemical production by Biocatalysts – Bulk chemicals, Pharmaceuticals, Flavour and Fragrance Compounds, Carbohydrates and Polymers - Green Biocatalystic processes – Biocatalysis in Supercritical Carbon dioxide, Biocatalysis in Waste treatment and Biodesulfarisation - Supported Reagents – Envirocats – Advantages – Activation – General methods for using Envirocats - Commercial Applications of Envirocats – Benzoylations, OlefinAlkylation, Sulfonylation, Esterificatins and Aerobic oxidation.

Text Book:

1. James Clark and Duncan Macquarrie, "Handbook of Green Chemistry and Technology", Blackwell Publishing, First Edition, ISBN – 0632057157, 2002.

Reference book

1. Stanley E. Manahan. "Green Chemistry and the Ten commandments of Sustainability", ChemChar Res. Inc., 2006. ISBN 0-9749522-4-9

U19FTPE 014   MECHANICAL SYSTEMS FOR FOOD PROCESSING   L T P C
                                                                    3 0 0 3

Course Objectives:

CO1: To learn about types of power transmission elements, steam generators and chillers.

CO2: To understand the principles of material handling systems.

Course outcomes:

CO1: To understand the working principle of pumps and their applications

CO2: To know about the various power transmission elements and their design.

CO3: To gain knowledge on working principle of boilers and me asur ement of per formance.

CO4: To study the working principle and appl ications of various mechanical refrigeration systems.

CO5: To learn about the principles and applications of different food chillers and freezers.

CO6: To appraise the construction and working principle of various material handling systems.

Unit I - FOOD PLANT PUMPS: **9**

Pumping theory- head developed-Types of pumps-Centrifugal pumps- Reciprocating pumps-Rotary gear pumps- vane pumps- and diaphragm pumps-peristaltic pump-construction- working principles and applications (Simple problems).

Unit II - MECHANICAL POWER TRANSMISSION SYSTEMS: 9

Types of shafts-design of shafts-solid and hollow shafts- types of coupling- belt drives-gear drives-chain drives and rope drives-types and materials (Simple problems).

Unit III - STEAM GENERATION AND DISTRIBUTION: **9**

Types of Water tube and smoke tube boilers- Boiler capacity- boiler specification- automatic boilers- Boiler mountings. Performance of steam generators (Simple problems).

Unit IV - REFRIGERATION SYSTEMS: **9**

Types of refrigeration systems- VCRs and VARs. Refrigerants, Components of refrigeration systems. Types of Chillers for Solid Foods, Types of Chillers for Liquid Foods, Types of Freezers. (Simple problems).

Unit V - MATERIAL HANDLING IN FOOD PLANTS: 9

Material handling in food plants & Importance, Belt Conveyor, Roller Conveyor, Vibratory Conveyor, Screw Conveyor, Slat Conveyor, Pneumatic Conveyor, Bucket Elevator.

Text Books

1. P.G.Smith, "Introduction to Food Process Engineering", Springer international Edition, 2005

2. R.Paul Singh,Dennis R.Heldman; "Introductin to Food Engineering" (3rd edition), Academic press, Elsevier, 2001.

Reference Books

1. R.K Rajput, "Thermal Engineering", Laxmi Publications, 2008.

2. R.K.Bansal; "Fluid Mechanics and Hydraulic Machines", Laxmi publications (P) Ltd, 2004

3. C.P. Arora, "Refrigeration and Air conditioning", Tata McGraw Hill, 2009.

U19FTPE015   **DRYING TECHNOLOGY**   **L T P C**
                                                                          3 0 0 3

Course Objectives:

CO1:To understand the basic theory of drying and its significance in food systems

CO2: To understand the importance of drying as a method of food processing

CO3: To learn about the relative advantages / disadvantages of each method of drying

Course Outcomes:

CO1: To gain knowledge on drying principles and psychrometric chart

CO2: To apply the principles to solve problem on drying

CO3: To understand different types of dryers for different food materials

CO4: To design dryers for different types of foods

CO5: To assess the concept behind industrial dryers

CO6: To evaluate the dryer performance

Unit I - THEORY OF DRYING: **9**

Principles of drying – Fundamentals of air-water mixtures – Psychrometric chart – Problems based on pyschrometry – Drying curves – constant and falling rate period - Heat and mass transfer in dryers – moisture content in foods – determination of moisture content and its measurement - methods of determination - Equilibrium moisture content – methods of determination – EMC models

Unit II - DRYING METHODS: **9**

Selection of dryers – design of dryers - Conduction drying – convection drying – Pneumatic or fluidized bed drying – natural air drying – heated air drying – recirculatory dryer (non-mixing type) – LSU dryer (continuous mixing type) – Baffle dryer - Radiation drying – Sun drying and infrared drying – Dielectric drying – chemical drying -Thin layer and deep bed drying - dryer performance

Unit III - DRUM DRYER, FOAM MAT DRYER AND FREEZE DRYER: **9**

Drum driers - Types of Drum Dryers - Principles of Operation of the Drum Dryer – rotary dryers Cabinet drying – vacuum tray dryers - Foam Mat Drying- Principles- Equipments- Factors affecting Foam mat drying – Freeze dryers - Fundamentals of freeze drying – Freezing – Primary drying stage – secondary drying stage -Changes during freeze drying – Condensation, defrosting – Industrial freeze driers.

Unit IV - FLUIDIZED BED DRYER, SPRAY DRYER, OSMOTIC DRYING: **9**

Fluidized bed dryer – Spouted bed dryer **-** spray drying of foods - Principles of Spray Drying Processes – Atomizers and nozzles - Reconstitution of powders – Foam spray drying - Osmotic dehydration – Principles – Factors affecting osmosis- Equipment used.

Unit V - RADIATION AND DIELECTRIC DRYERS: **9**

Infrared drying – principles - microwave drying of foods – dielectric concepts – construction and working – Radio Frequency drying – principles – working - Flash Dryers - Design of Flash Dryers - Materials Dried in Flash Dryers.

Text Books

1. Arun S. Mujumdar, "Handbook of Industrial Drying", CHIPS, 3rd Edition, 2006.

2. Chakraverty. A. " Post Harvest Technology of Cereals, Pulses and Oil seeds", Oxford and IBH Publishing Co.Pvt. Ltd. New Delhi, 2014.

Reference Books

1. Paul Singh, R and Dennis R. Heldman.. Introduction to Food Engineering Academic Press, 2001

2. Hui Y. H,:"Food Drying Science and Technology, Microbiology, Chemistry, Application", CHIPS, 2008.

3. Loesecke,H. W. V, "Drying & Dehydration of Foods", Published by Agrobios, 2005

APPROVED BY BOS CHAIRMAN

U19FTPE016　　　　　　**MANAGEMENT OF FOOD WASTE**　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

Course Objectives:
- Importance of treating waste product from food industry.
- Treatment methods and recycling of waste product from food industry.
- Understand the classification and characterization of food industrial waste
- Understand the fruit and vegetable waste processing and by-products
- Knowledge the waste management treatment and cleaning in practices

UNIT I CLASSIFICATION & CHARACTERIZATION OF FOOD INDUSTRY WASTE　　　**9**

Classification and characterization of waste from various food industries; Need for treating waste from various food industries.

UNIT II WASTE FROM MEAT, DAIRY AND VEGETABLE PROCESSING INDUSTRY　　　**9**

Classification, analysis and disposal of waste from meat; Bioremediation and utilization of dairy waste. Treatment of water from fruit and vegetable processing industry.

UNIT III TREATMENT METHODS OF WASTE FROM FOOD INDUSTRY　　　**9**

Treatment methods for liquid waste from food industry; Design of activated sludge process, bioremediation, trickling filter process and Anaerobic Digestion Treatment methods for solid waste from food industry-drying, incineration and Design of solid waste management.

UNIT IV RECYCLING AND UTILIZATION OF WASTE PRODUCT FROM FOODINDUSTRY　**9**

Treatment of water from food industry -BOD, COD, RO. Recovery of protein from potato starch plant, utilization of molasses, utilization of waste from meat and fish for live-stock and poultry.

UNIT VREGULATORY ISSUES WITH FOOD INDUSTRY WASTE　　　　　　**9**

International and national scenario on disposal of waste from food industries; Regulatory issues with food industry waste.

Course Outcomes:
CO1:Awareness of Importance in treating waste product from food industry.
CO2: Knowledge of Treatment methods and recycling of waste product from food industry.
CO3: Understanding the classification and characterization of food industry waste
CO4: Develop innovative products from waste from fruits and vegetables
CO5: Understanding the treatment methods of waste from food industry
CO6: Knowledge on recycling and utilization of waste from food industry

　　　　　　　　　　　　　　　　　　　TOTAL: 45HOURS

TEXT BOOKS:

1. Herzka, A. and Booth, R.G. ―Food Industry and Trade: Recycling Waste‖. AppliedScience Publishers, 1981.

U19FTPE017   **FUNCTIONAL FOODS AND NUTRACEUTICALS**   **L T P C**
                                                                        3 0 0 3

Course objectives:

To understand the basics of nutraceuticals and functional foods
• To study the significance of nutraceuticals and their role in disease prevention
• To identify new strategies for marketing of traditionally known nutraceuticals

Course Outcomes:

• To understand the importance of Functional food for preventive therapy
• To develop methods for extraction and identification of nutraceutically significant molecules.

UNIT I-NUTRACEUTICALS: HISTORICAL, TECHNOLOGICAL ASPECTS AND CLASSIFICATIONS   9

Introduction – Historical Reviews - Teleology of nutraceuticals - Organization models for nutraceuticals – Classification of Nutraceuticals based on the sources– Animal, Plant and Microbial – Nutraceuticals in specific foods - Mechanism of Action - Chemical nature.

UNIT II- FLAVANOIDS AND CAROTENOIDS AS ANTIOXIDANTS   9

General background onphytochemicals as antioxidants - Flavonoids and Lipoprotein oxidation - Evidence forspecific Antioxidant mechanisms of Flavonoids - Dietary carotenoid and carotenoidabsorption - Approaches to measurement of absorption - Metabolism of Carotenoids – Carotenoids as anticancer agents.

UNIT III-OMEGA-3 FATTY ACIDS AND CLA   9

Introduction to Lipoprotein metabolism – PUFAand Cardiac Arrhythmias - Preventative role of n-3 fatty acids in cardiac arrhythmias -Mechanism of action on n-3 PUFA's - ω – 3 fish oils and their role in Glycemic control- ω –3 fatty acids and rheumatoid arthritis - Chemistry and Nomenclature of CLA – Analysis of CLA in food and biological samples – CLA in food products and biological samples –Biological actions and potential health benefits of CLA – Mechanisms of CLA action – Potential adverse effects of CLA

UNIT IV-LYCOPENE, GARLIC, OLIVE OIL, NUTS, PROBIOTICS AND PREBIOTICS   9

Lycopene overview – lycopene and disease - Garlic – Chemistry – Implication in Health - Olive oil – CHD – Cancer - Nuts – Nutrient components and Composition – Nut Consumption and CHD epidemiological evidence, Human nutritional studies on nut consumption and serum lipid changes, Mechanism of action- Probiotics- criteria – products on market – probiotic products – Microbiology of the gastrointestinal tract - Prebiotics – future for probiotics and prebiotics.

UNIT V-HERBS AS FUNCTIONAL FOODS, STABILITY, TESTING AND MARKETING ISSUES FOR NUTRACEUTICALS AND FUNCTIONAL FOODS   9

Herbal medicine – Herbs as ingredients in functional foods – actions of herbal and evidence of efficacy - Kinetic modelling of chemical reactions – Accelerated shelf life testing - Evolution of marketing environment for Functional foods and nutraceuticals - Regulatory background - Introduction to consumer marketing issues for nutraceuticals - Potential product positioning.

                                        TOTAL – 45 HOURS

TEXTBOOKS

1. Shi, John, Fereidoon Shahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor & Francis, 2007
2. Watson, Robald Ross "Functional Foods and Nutraceuticals in Cancer Prevention". Blackwell Publishing, 2007.
3. Gibson, G.R. and C.M.Willams. "Functional Foods : Concept to Product". Woodhead, 2000

REFERENCE BOOKS

1. Bisset, Normal Grainger and Max Wich H "Herbal Drugs and Phytopharmaceuticals", 2nd Edition, CRC, 2001.
2. Wildman, Robert "Handbook of Nutraceuticals and Functional Foods". CRC, 2006.
3. Webb, P P. "Dietary Supplements and Functional Foods". Blackwell, 2006.
4. Ikan, Raphael "Natural Products: A Laboratory Guide", 2nd Edition, Academic Press / Elsevier, 2005.

                                                      APPROVED BY BOS CHAIRMAN

U19FTPE018   **TOTAL QUALITY MANAGEMENT**   **LTPC**
                                                                       3003

Course Objective:

- To facilitate the understanding of Quality Management principles and process.

UNIT I   INTRODUCTION   9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II   TQM PRINCIPLES   9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III   TQM TOOLS AND TECHNIQUES I   9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV   TQM TOOLS AND TECHNIQUES II   9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V   QUALITY MANAGEMENT SYSTEM   9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector- Specific Standards— AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements— Implementation—Documentation— InternalAudits—Registration.

                                                                    TOTAL: 45HOURS

Course Outcome:

To apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ‒Total Quality Management‖, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1.James R. Evans and William M. Lindsay, "The Management and Control ofQuality ",8th Edition, First Indian Edition, Cengage Learning, 2012.

2.Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", PrenticeHall(India) Pvt. Ltd., 2006.

3.Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India)Pvt. Ltd.,2006.

U19FTPE019   FOOD PROCESSING AND PRESERVATION   L T P C

3 0 0 3

Course Objective:

CO1: To expose the students to the principles and different methods of food processing and preservation.

UNIT I PRINCIPLES OF MASS AND ENERGY BALANCE   9

Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes and freezing. Thermal processing; calculation ofprocess time temperature-schedules.

UNIT II CANNING OF FOOD PRODUCTS   9

Newer methods of thermal processing; batch and continuous; application of infra-red microwaves; ohmicheating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT III DRYING PROCESS FOR TYPICAL FOODS   9

Rate of drying for food products; design parameters of different type of dryers; properties of airwater mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydrofreezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT IV NON-THERMAL METHODS   9

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,

UNIT V FOOD PACKAGING   9

Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials.

TOTAL: 45 HOURS

Course Outcomes:

To understand the principles of food processing and preservation.

CO1: To understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.

CO2: To familiarize with the recent methods of minimal processing of foods To understand the materials and types of packaging for foods

TEXT BOOKS:

1. Sivasankar, B. "Food Processing and Preservation". Prentice Hall of India, 2002.

2. Khetarpaul, Neelam. "Food Processing and Preservation." Daya Publications, 2005

3. Singh, M.K. "Food Preservation" Discovery Publishing, 2007.

4. Fellows, P.J. "Food Processing Technology: Principles and Practice". 2nd Edition, CRC Wood Head Publishing, 2000.

5. GopalaRao, Chandra. "Essentials of Food Process Engineering". B.S. Publications, 2006.

REFERENCES:

1. Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.

2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003

APPROVED BY BOS CHAIRMAN

U19FTPE020   FOOD SUPPLY CHAIN MANAGEMENT   L T P C
                                                                  3 0 0 3

Course Objectives:

To enable the students understand

CO1: fundamentals on logistics and supply chain management.

CO2: to take up the logistics and supply chain activities in food industries.

CO3: To knowledge the various methods of supply chain management.

Course Outcomes:

On completion of the course, the students will be able to

1. Learn the methods of logistics.

2. Understand the concepts of supply chain management.

3. Get technical and IT exposure in LSCM.

4. Empower the students in the field of logistics and supply chain management.

5. Design logistics and supply chain management for food industries.

6. Handle supply chain in corporate arena.

UNIT 1 INTRODUCTION   9

Logistics and supply chain management - Scope, Significance and Drivers; Basic Model – Primary and Secondary Activities; Role and Challenges of Logistics and supply chain management in food industry.

UNIT 2- PROCUREMENT AND WAREHOUSING   9

Demand and supply management, Forecasting techniques, Strategic planning for material sourcing, Outsourcing strategies, Warehouse strategies, Inventory models and control techniques

UNIT 3 - DISTRIBUTION AND TRANSPORTATION   9

Various sources of distribution channels, Distribution models, 3PL and 4PL, Distribution network planning, Modes of transportation, Design of transshipment .

UNIT 4- PACKAGING AND INFORMATION TECHNOLOGY   9

Applications of Packaging in logistics, Types of packaging and packaging materials, Export & import packaging and labeling details, Containerization, Pervasiveness of IT in Supply Chain Management – ERP, Bar-coding, RFID, GPS, E-Procurement.

UNIT 5 - GLOBAL LSCM   9

Export and import procedure and Documentation, Risk management in global logistics, Customer relationship management in LSCM

                                        TOTAL – 45 HOURS

Text Book

1. D K Agarwal, Logistics and supply chain management, Macmillan Publishers India Ltd., Eighth Impressions, 2010.

Reference Books

1. Sunil Chopra and Peter Meindi, Supply chain management Pearson Education publishers, 2010

2. David Taylor and David Brunt, Manufacturing Operations and Supply chain Management, Vikas Thomson Learning publishers, 2009.

AGRICULTURAL ENGINEERING

OPEN ELECTIVE I

U19AEOE001	AGRICULTURAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

To impart knowledge to students on various methods of agricultural waste management for eco-friendly energy and manure production.

PREREQUISITES: NIL

Course Articulation Matrix : 3- High, 2- Medium, 1- Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1											2	2
CO2	3	2	2											3	3
CO3	2	1	1											2	2
CO4	2	1	1											2	2
CO5	2	1	1											3	3
CO6	2	1	1											2	2

UNIT I   **INTRODUCTION**   **10**

Availability of different types of agriculture wastes - its overall characteristics – classification of agro wastes based on their characteristics- its recycling and utilization potential- current constraints in collection and handling of agricultural wastes – its environmental impact.

UNIT II   **COMPOSTING**   **8**

Definition- Solid waste suitable for composting – Methods of composting - vermicomposting - Mineralization process in composting - Biochemistry of composting – Factors involved – Infrastructure required – maturity parameters – value addition – application methods

UNIT III   **BIOMASS BRIQUETTING**   **9**

Definition – potential agro residues and their characteristics for briquetting – fundamental aspects and technologies involved in briquetting – economic analysis of briquetting – setting up of briquetting plant- appliances for biomass briquettes.

UNIT IV   **BIOCHAR PRODUCTION**   **9**

Definition - characteristics of agro wastes suitable for Biochar production – Methods of Biochar production – fast and slow pyrolysis – characteristics of Biochar – role of Biochar in soil nutrition and carbon sequestration

UNIT V   **BIOGAS AND BIO ETHANOL PRODUCTION**   **9**

Screening of suitable lingo cellulosic substrate for biogas production -determination of bio-energy potential of agro-waste by estimating total solids - volatile solids - Calorific value- per cent total carbohydrates, moisture, lignin and cellulosic contents – preparation of feed stocks for anaerobic bio- digestion – types of digesters – factors affecting - nutrient value and utilization of biogas slurry. Ethanol production from lingo cellulosic wastes - Processing of Biomass to Ethanol –pre- treatment-fermentation-distillation

Total: 45 HOURS

Course Outcomes:

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At the end of the course students should be able to

CO1   Build various eco-friendly methods for agricultural waste management
CO2   To develop the process of composting of different types of solid wastes
CO3   To understand the techniques of briquetting from agro-residues
CO4   To understand the role of biochar in soil nutrition and carbon sequestration
CO5   Nutritive value and energy production potential of agro wastes
CO6   To develop and understand the techniques for processing of ethanol and biogas production

TEXT BOOKS:

T1:   Rai G.D,Non conventional sources of Energy, Khanna publishers, New Delhi, 1995.
T2:   Diaz,l.F.,M. de Bertoldi and W. Bidlingmaier. 2007. Compost science and technology, Elsevier pub., PP.1-380.

REFERENCE BOOKS:

R1:   P.D. Grover & S.K. Mishra, "Biomass Briquetting: Technology and Practices". Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
R2:   Magdalena Muradin and Zenon Foltynowicz, "Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland". Sustainability, 2014, 6, 5065-5074.
R3:   Biochar production from agricultural wastes via low-temperature microwave carbonization

U19AEOE002	FARM MANAGEMENT	L	T	P	C
		3	0	0	3

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Course Objectives:
- To impart the fundamental knowledge and basic concepts of Economics and Farm Management
· To understand the types of resources and Investment analysis in agriculture sector
· To understand the Farm financial analysis, Investment and Budgeting for farms.
· To expose the students to different extension methods for communication to take the work from lab to field
· To plan the financial aspects, economics related to farm management in a cost effective manner.

PREREQUISITES: NIL

Course Articulation Matrix : 3- High, 2- Medium, 1- Low														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	–	–	–	–	–	–	–	–	–	–	–	–	–	
CO2	3	–	–	–	–	–	–	–	–	–	–	–	–	–	
CO3	3	2	2	2	–	–	–	–	–	–	–	–	–	-	-
CO4	3	2	2	2	–	–	–	–	–	–	–	–	–	–	
CO5	3	3	2	2	–	–	–	–	–	–	–	–	–	1	1
CO6	2	3	2	1										1	1

UNIT I   FARM MANAGEMENT & PLANNING   10

Farm Management – definition – scope- Classification of farms – Basic concepts in farm management -
Relationship between farm management and other basic sciences - Farm layout – Farm records and accounts–
Farm appraisal techniques – Valuation - Farm management- need and analysis –Elements of farm planning–
Whole farm planning and partial planning – Farm level management system – Farm budgeting – whole farm
budgeting and partial budgeting – Estimation of credit - examples of farm planning and budgeting

UNIT II   LAWS OF ECONOMICS   8

Agricultural Economics – definition and scope – Basic laws of economics – demand and supply concepts –
law of increasing, diminishing and constant returns – Equi-marginal returns - Product relationship –
Production function – definition and types – Production function curves – Optimum level of input use –
Economies of scale external and internal economies and diseconomies - Cost concepts – types - Opportunity
cost – comparison of costs – Factor relationship – concepts.

UNIT III   COST CURVES   10

Principle of substitution – isoquant, isocline, expansion path, ridge line and least cost combination of inputs-
Product-product relationship – Production possibility curve, isorevenue line and optimum combination ofoutputs
– Cost curves –Optimum input and output levels – Factor &relationship – Least cost combination ofinputs –
Estimation of cost of cultivation and cost of production of crops - anual and perennial crops

UNIT IV   MANAGEMENT OF RESOURCESAND FINANCIAL ANALYSIS   9

Concept of risk and uncertainty – causes for uncertainty – Managerial decisions to reduce risks in production
process – Management of resources – types of resources- land, labour, capital and measurement of their
efficiencies – Mobilization of farm resources- Cost of machinery and maintenance – Break even analysis –
Investment analysis – Discounting techniques- Farm financial analysis – Balance sheet – Income statement –
Cash flow analysis – Farm investment analysis – Time comparison principles - Preparation of interview
schedule and farm visit for data collection.

UNIT V   AGRICULTURAL EXTENSION   8

Communication – models – elements and their characteristics – types and barriers - Programme planning –
monitoring and evaluation - Extension teaching methods - Audio-Visual aids – classification – purpose,

planning and selection – individual, group and mass contact methods –Modern communication sources – internet, video and teleconferencing, Interactive Multimedia Compact Disk (IMCD), village kiosks, Kissan Call Centre (KCC), mobile phone – Diffusion - Adoption –Capacity building of extension personnel and farmers –types of training, training to farmers, farm women and rural youth, FTC & KVK.

Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to

CO1 Gain knowledge in various farm management and farm layout aspects

CO2 Familiarize with the various laws of economics and product relationship aspects

CO3 Gain knowleddge on cost curvesand its applications

CO4 Understand about the various concepts of mamagement of resources

CO5 Gain knowleddge on farm management and financial analysis

CO6 Familiarize with budgeting and cost estimation for farm layout

TEXT BOOKS:

T1: Johl, S.S., and Kapur, T.R.,Fundamentals of Farm Business Management", Kalyani publishers, Ludhiana, 2007

T2: Subba Reddy, S., Raghu Ram, P., NeelakantaSastry T.V and Bhavani 3. Devi, I., "Agricultural Economics"Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.

REFERENCE BOOKS:

R1: Raju, V.T., "Essentials of Farm Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.

R2: Subba Reddy, S., and Raghu Ram, P. „ "Agricultural Finance and Management", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2002.

OPEN ELECTIVE II

U19AEOE003   **Introduction to Bio-Energy**   **L**   **T**   **P**   **C**

Course Objectives:

To introduce to the students the concepts of bio energy resources
· To expose the students to types of energy resources
· To enhance knowledge on estimation of bio energy plants.
· To expose the students to bio fuel production.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO2	PSO3
					Course Articulation Matrix : 3- High, 2- Medium, 1- Low									
CO1	3	2				2	2						2	2
CO2	3	2				2	2						3	3
CO3	3	2				2	2						2	2
CO4	3	2				2	2						2	2
CO5	3	2				2	2						3	3
CO6	3	2				2	2						2	2

UNIT I   BIO RESOURCE - AN INTRODUCTION   9

Bio resource – origin – biomass types and characteristics- biomass conversion technology- Biodegradation - steps in biogas production- parameters affecting gas production- Types of biogas plants- Construction details- operation and maintenance.

UNIT II   BIO ENERGY   9

Slurry handling- enrichment and utilization – Biogas appliances- Biochemical characteristics of bio resources- Bioenergetics –Biocatalysis –Kinetics of product formation.

UNIT III   BIO REACTORS AND FERMENTORS   9

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological waste water treatment- Activated sludge process- Down-stream processing-Recovery and purification of products.

UNIT IV   ALCOHOL PRODUCTION   9

Alcohol ethanol production - Acid hydrolysis - enzyme hydrolysis-Methanol synthesis - Antibiotics- enzymes- principles of thermochemical conversion – combustion - pyrolysis-Gasification – types of gasifiers

UNIT V   ENERGY AND ENVIRONMENT   9

Principles of operation- chemical reaction- cleaning and cooling - Utilization- Improved wood burning stove - Energy plantations- Biomass briquetting - co generation- Impact on Environment – Bioenergy policy.

Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to
CO1   Understanding the importance of bio resources.
CO2   Ability to classify the bio energy and characteristics of bio energy.
CO3   Knowledge in bio reactors and fermenters.
CO4   Ability to gain knowledge in Alcohol production process
CO5   Understanding the importance of Energy and Environment
CO6   Knowledge in capturing and applying bioenergy on replacement of fossil fuels.
TEXT BOOKS:
  T1:   Rai G.D,Non-conventional sources of Energy, Khanna publishers, New Delhi, 1995.

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T2: Bouley James .E & David Follis - Biochemical Engineering Fundamentals Mc Graw-Hill publishing company, Tokyo.1986

REFERENCE BOOKS:

R1: Chawla O.P, Advances in Biogas Technology ICAR publication New Delhi 1986

R2: Khandelwal K.C. and Mahdi, S.S. 1986. Biogas Technology. Tata Mc Graw Hill Pub. Co. Ltd., New Delhi.

R3: Srivastava, P.K., Shukla, B.D. and Ojha, T.P. 1993. Technology and application of biogas. Jain Brothers, New Delhi.

R4: Mathur,A.N.and Rathore,N.S.1993.,Biogas production Management and Utilisation. Himanshu Publication. NewDelhi

U19AEOE004	ROBOTICS IN AGRICULTURE	L	T	P	C
		3	0	0	3

APPROVED BY BOS CHAIRMAN

COURSE OBJECTIVES
- To introduce the overview of robotic systems and their dynamics
- To impart knowledge on system stability
- To acquire knowledge on joint space and task space control schemes
- To understand the concept of nonlinear control and observer schemes

PREREQUISITES: NIL

Course Articulation Matrix : 3- High, 2- Medium, 1- Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	–	–	–	–	–	–	–	–	–	–	–	–	–	
CO2	3	–	–	–	–	–	–	–	–	–	–	–	–	–	
CO3	3	2	2	2	–	–	–	–	–	–	–	–	–	-	-
CO4	3	2	2	2	–	–	–	–	–	–	–	–	–	–	
CO5	3	3	2	2	–	–	–	–	–	–	–	–	–	1	1
CO6	2	3	2	1										1	1

UNIT I   INTRODUCTION AND OVERVIEW OF ROBOTIC SYSTEMS AND THEIR DYNAMICS   10

Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes.

UNIT II   SYSTEM STABILITY AND TYPES OF STABILITY   8

Lyapunov stability analysis, both direct and indirect methods. Lemmas and theorems related to stability analysis.

UNIT III   JOINT SPACE AND TASK SPACE CONTROL SCHEMES   10

Position control, velocity control, trajectory control and force control.

UNIT IV   NONLINEAR CONTROL SCHEMES   9

Proportional and derivative control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer based control, robust control and optimal control

UNIT V   NONLINEAR OBSERVER SCHEMES: 8

Design based on acceleration, velocity and position feedback. Numerical simulations using software packages namely MATLAB/MATHEMATICA.

Total: 45HOURS

Course Outcomes:

At the end of the course students should be able to

- **CO1**   Understand basic concept of robotic systems and their dynamics.
- **CO2**   Analyze system stability and types of stability
- **CO3**   Know about joint space and task space control schemes
- **CO4**   Understand the concept of nonlinear control and observer schemes
- **CO5**   Gain knowledege on farm management and financial analysis
- **CO6**   Familiarize with budgeting and cost estimation for farm layout

TEXT BOOKS:

T1:   R Kelly, D. Santibanez, LP Victor and Julio Antonio, ―Control of Robot Manipulators in Joint Space‖, Springer, 2005.

REFERENCE BOOKS:

R1:   R M Murray, Z. Li and SS Sastry, ―A Mathematical Introduction to Robotic Manipulation‖, CRC Press, 1994.

BIOMEDICAL ENGINEERING

OPEN ELECTIVE I

U19BMOE001   BIO HEALTHCARE AND TELEMEDICINE   L   T   P   C
                                                                                          3   0   0   3

Course Objective

The student should be made:

- To enable the students to acquire knowledge about the principles and application of telemedicine in biomedical industry

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.1	2	2	3	1									2	2
CO.2	2	2	3	1									2	2
CO.3	2	2	3	1									2	2
CO.4	2	2	3	1									2	2
CO.5	3	2	3	1									3	2
CO.6	2	2	3	1									2	2

UNIT I   BACKGROUND OF TELEMEDICINE   9

Introduction ,definitions of telemedicine, telehealth and telecare, Origins and development of telemedicine: from beginning to modern times, modern telemedicine and telecare Drivers of telemedicine and telecare: technology drivers, non technological drivers, the funding dilemma Telemedicine in developed and underdeveloped countries ,benefits and limitations of telemedicine Types of information and transmission in telemedicine: audio, video, still images, text and data, Fax

UNIT II   COMMUNICATION AND NETWORK SYSTEMSIN TELEMEDICINE   9

Types of communication and network: public switched telephone network, plain old telephone service, integrated services digital network, internet, asynchronous transfer mode Wireless communications basics and its types Wireless sensor standards and homecare concerns, medical sensors for mobile communication devices Development of disposable adhesive wearable human monitoring system Implantable systems: implantable system architecture Signal Processing in implantable neural recording microsystems, electronic health signal processing

UNIT III   TECHNOLOGIES FOR SAFEGUARDING MEDICAL DATA AND PRIVACY   9

Data Exchanges: Network configuration, circuit and packetswitching, H.320 series Data security and standards: Encryption, cryptography, mechanisms of encryption, phases of encryption Cryptography, safeguarding patient medical history Anonymous data collection and processing, biometric security and identification

UNIT IV   TELEHEALTH AND MOBILE HEALTH   9

Medical robotics: surgical robots, rehabilitation robots Modern devices for tele-surgery: Main component and functionalities of a robotics tele-surgery System, design guidelines and methodology Microsurgery Systems: Robot-assisted microsurgery system,miniaturization, microsurgical tools, visualization methods and systems Image-guided microsurgery: Image guidance component and workflow, image guidance by surgical domain

**UNIT V   IMPLEMENTATION OF TELEMEDICINE AND FUTURE TRENDS IN   9
             TECHNOLOGY**

Telecardiology: Tools and devices Teleradiology and Tele-audiology Telepathology system development and implementation Acute care telemedicine and monitoring for elderly care Virtual doctor systems for medical practices, wireless electrical impedance tomography Synthetic biometrics in biomedical systems, bio-kinematics for mobility

Total:45 HOURS

Course Outcomes:

At the end of the course students should be able to

CO1: Explain the development and transmission techniques used in telemedicine
CO2: Describe the types of communication and network systems
CO3: Explain the technologies used in data exchange and privacy of telemedicine
CO4: Illustrate the current system of tele-health and mobile health
CO5: Describe the currents and futures perspective of telemedicine
CO6: Acquire knowledge about the principles and application of telemedicine

TEXTBOOKS:

T1 Bernard Fong, A.C.M. Fong, C.K. Li, ‒Telemedicine Technologies: Information Technologies in Medicine and Telehealth‖, Wiley, 1ˢᵗ edition,2010.
T2 HalitEren,JohnG.Webster,―TheE-Medicine,E-Health,M-Health,Telemedicine,and   Telehealth Handbook‖, CRC Press,1ˢᵗ edition, 2015.
T3 OlgaFerrer-Roca,M.SosaLudicissa,―HandbookofTelemedicine‖,IOSpress,1ˢᵗedition,2002.

REFERENCEBOOKS:

R1 GeorgiGraschew,StefanRakowsky,―TelemedicineTechniquesandApplications,In   ech, 1ˢᵗedition,2011
R2 A.C.Norris,―EssentialsofTelemedicineandTelecare,JohnWiley&Sons,1ˢᵗedition**,**2002.
R3 RichardW.Carlson,‒TelemedicineintheICU, AnIssueofCriticalCareClinics,(The Clinics: Internal Medicine)‖, Elsevier, 1ˢᵗ edition,2015.

U19BMOE002	EMBEDDED SYSTEMS IN MEDICAL DEVICES	L	T	P	C
		3	0	0	3

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Course Objective

The student should be made:

- Understand the design of embedded system for various medical devices.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.1	2	2	2	2	2	2					2	2	3	3
CO.2	2	2	2	2	2	2					2	2	3	3
CO.3	3	3	2	3	2	1					2	2	2	2
CO.4	3	3	3	2	2	2					2	2	2	2
CO.5	2	2	2	3	2	1					2	2	2	2
CO.6	2	2	2	2	2	1					2	2	2	2

UNIT I   EMBEDDED DESIGN WITH MICROCONTROLLERS   9

Product specification – hardware / software partitioning- Detailed hardware and software design – integration,product testing- Microprocessor Vsmicro controller- Performance tools, bench marking processors- RTOS micro controller -issues in selection of processors.

UNIT II   PARTITIONING DECISION   9

Hardware / software duality- Hardware-software portioning, coding for hardware/software development, ASIC revolution- Managing the risk,co-verification, execution environment- Memory organization of controller, memory enhancement- Firmware, speed and code density, system startup.

UNIT III   FUNCTIONALITIES FOR SYSTEM DESIGN   9

Timers, watch dog timers- RAM, flash memory, basic toolset, integration of hardware & firmware- Application programming, IDE, target configuration- Hostbaseddebugginganalyser- Remote debugging, ROM emulators, logic

UNIT IV   DESIGN OF PATIENT MONITORING DEVICES   9

Design consideration of patient monitoring systems- Basic block diagram of pulse oximeter, design requirementof device- Circuit implementation of interfacing of oximeter sensors with microcontroller- Software coding and implementation.

UNIT V   DESIGNING OF PACEMAKER   9

System description of pacemaker- Design requirement and basic block diagram of pacemaker- Interfacing of pacemaker elements with processors- Software coding of pacemaker and implementation.

Total:45 HOURS

Course Outcomes:

At the end of the course students should be able to

CO1: Attain knowledge on the basic concepts and the building blocks for embeddedsystem

CO2: Understand the hardware and software partitioning in embeddedsystems

CO3: Gain knowledge about timers and memory organization of embeddedsystems

CO4: Design a pulse oximeter using embedded tool

CO5: Design a pacemaker using embedded tool

CO6: Understand the design of embedded system for various medical devices

TEXTBOOKS:

T1   James K. Peckol, ―Embedded system Design‖, John Wiley & Sons, 1ˢᵗ edition, 2010

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REFERENCEBOOKS:

R1 Geo EliciaWhite,―MakingEmbeddedSystems‖,O'ReillySeries,SPD,1stedition,2011.Georgi Graschew StefanRakowsky,―TelemedicineTechniquesandApplications,In Tech, 1stedition,2011

R2 G. Baura, "A Biosystems Approach to Industrial Patient Monitoring and DiagnosticDevices‖, Morgan&Claypool, IEEE,2008.

OPEN ELECTIVE II

APPROVED BY BOS CHAIRMAN

			L	T	P	C

U19BMOE003 **HOSPITAL MANAGEMENT SYSTEM**   L T P C
3 0 0 3

Course Objective:

The student should be made:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.1	3	2	3	3		1	2				1		2	2
CO.2	2	3	3	3		1	3				1		3	2
CO.3	2	3	3	3		1	3				1		3	3
CO.4	3	2	3	3		1	2				1		2	3
CO.5	2	2	3	3		1	2				1		2	2
CO.6	2	2	3	3		1	2				1		2	2

UNIT I   **OVERVIEW OF HOSPITAL ADMINISTRATION**   **9**

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio Medical Waste Management.

UNIT II   **HUMAN RESOURCE MANAGEMENT IN HOSPITAL**   **9**

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.

UNIT III   **MARKETING RESEARCH PROCESS**   **9**

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.

UNIT IV   **HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES**   **9**

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department –Pharmacy– Food Services - Laundry Services.

UNIT V   **QUALITY AND SAFETY ASPECTS IN HOSPITAL**   **9**

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 HOURS

Course Outcomes:

At the end of the course, learners will be able to:

CO1: Explain the principles of Hospital administration.
CO2: Identify the importance of Human resource management.
CO3:List various marketing research techniques.
CO4: Identify Information management systems and its uses.
CO5: Understand safety procedures followed in hospitals
C06: Analyze the quality and safety aspects in hospital.

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TEXT BOOKS

1. R.C.Goyal, ―Hospital Administration and Human Resource Management‖, PHI – Fourth Edition, 2006.
2. G.D.Kunders, ―Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, ―The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, ―Handbook of Health Care Human Resources Management‖, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman ―Health Sector Reform in Developing Countries‖ - Harvard University Press, 1995.
4. William A. Reinke ―Health Planning For Effective Management‖ - Oxford University Press.1988
5. Blane, David, Brunner, ―Health and SOCIAL Organization: Towards a Health Policy for the 21st Century‖, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, ―Health Care Management‖, 6th Edition Cengage Learning, 2011.

U19BMOE004	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objective:

The student should be made:

To impart knowledge of the principle of operation and design of sensory equipment's.

To render a broad and modern account of neurological, muscular, cardiological and respiratory instruments.

To introduce idea about instrumentation in patient care and diagnosis.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.1	2	2	2	2	2	2					2	2	3	3
CO.2	2	2	2	2	2	2					2	2	3	3
CO.3	3	3	2	3	2	1					2	2	2	2
CO.4	3	3	3	2	2	2					2	2	2	2
CO.5	2	2	2	3	2	1					2	2	2	2
CO.6	2	2	2	2	2	1					2	2	2	2

UNIT I   RECORDING OF BIOSIGNALS   9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, Lead configuration, 12 lead ECG machine circuit, common mode and interference reduction circuits, Vector cardiograph EEG – 10-20 electrode system. EMG– Recording, Electro encephalogram, Magneto encephalogram, EOG & ERG: origin, measurement of EOG, electroretinogram

UNIT II   SENSORY INSTRUMENTATION   9

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Hearing and speech aids: conductive and nervous, hearing aids- Types, constructional and functional characteristics. Cochlear implants- Need, constructional details, speech trainer.

UNIT III   CARDIAC EQUIPMENTS   9

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types. EEG diagnostic interpretation, recording and analysis of EMG waveforms.

UNIT IV   RESPIRATORY MEASUREMENT SYSTEM   9

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT V   ADVANCED DEVICES   9

Cardiac pacemakers and modern stimulators, Hemodyalysis ventilators, incubators, drug delivery devices, surgical instruments, Therapeutic application of laser, Neonatal Monitoring.

Total:45 Hours

Course Outcomes:
At the end of the course students should be able to
CO1:   Demonstrate the principle of operation and design of sensory equipments
CO2:   Determine the basic parameters of the equipment used in patientdiagnosis
CO3:   Analyze the broad and modern account of neurological equipments.
CO4:   Illustrate the principle and working of muscular and respiratory instruments
CO5:   Render a broad and modern account of neurological, muscular, cardiological and respiratory instruments..

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CO6: Gain idea about instrumentation in patient care and diagnosis.

TEXTBOOKS:

T1 SiamakNajarian, Javad Dargahi, Ali AboueiMehrizi, ―Artificial Tactile Sensing in Biomedical Engineering‖,McGraw Hill publication,2009

T2 Martin Grunwald, ―Human HapticPerception‖, Birkhaeuser Verlag AG, Boston Basel Berlin publication,2008

REFERENCE BOOKS:

R1 Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Cha,―Haptics Technologies: Bringing touch to multimedia‖, Springer,2011

R2 MyerKutz.,―BiomedicalEngineeringandDesignHandbook‖Vol2,McGrawHill

BIOTECHNOLOGY

OPEN ELECTIVE – I

U19BTOE001	BASICS OF BIOINFORMATICS	L	T	P	C
		3	0	0	3

Course Objectives:

To enable the students

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science

Course Outcomes:

At the end of the course, learners will be able to

CO1. Use bioinformatics tools with programming skills.

CO2. Apply computational based solutions for biological perspective

CO3. Alignment of nucleotide and protein sequences

CO4. Predict gene and protein structure.

CO5. Construct, interpret and assess the different molecular phylogenetic tree prediction and gene prediction algorithms

CO6. understand the Application of Bioinformatics

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		1				2									
2			3		2	3									1
3			2		3	3									1
4		3	2			2								1	1
5			2		2	3								2	
6	1				1									2	

3 - High, 2 - Medium, 1 – Low

UNIT I   DATABASES   9

Introduction to Bioinformatics-Biological information resources-Genome sequence acquisition and analysis-Retrieval of biological data-Data acquisition, databases, structure and annotation-Data mining and data characteristics.

UNIT II   SEQUENCE ALIGNMENT AND DATABASE SEARCHES   9

Database searches and Sequence Alignment-Pair wise and multiple sequence alignment-Methods of local and global alignment-Dynamic programming, Scoring matix, PAM, searching sequence databases by sequence similarity-BLAST and FASTA.

UNIT III   PHYLOGENY ANALYSIS   9

Phylogenetics, Molecular Phylogeny and evolutionary analysis-ClustalW, MSA, Dendrogram-Maximum likelihood, Maximum Parsimony, convergent and parallel evolution, Bootstrapping, Jackknifing-Phylograms.

UNIT IV   STRUCTURAL BIOINFORMATICS   9

Structural bioinformatics, analysis for protein structure, Predicting protein structure and function from Sequence-Homology modeling-Microarray Data analysis- proteomic data analysis-Visualization of molecular structures.

UNIT V   APPLICATIONS OF BIOINFORMATICS   9

Scope of bioinformatics-Bioinformatics in the Pharmaceutical Industry- Structure-Based Rational Drug Design and discovery-Chemi-informatics in Biology.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Attwood, T. and P.S. David. 2006. Introduction to Bioinformatics. Pearson Education Ltd., New York.
2. Axevanis, A.D., and Ouellette, B.F.F. (eds) 2006. Bioinformatics A Practical Guide to Analysis of Genes and Proteins. 3rd Edition, John Wiley and Sons, New York.

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	L	**T**	**P**	**C**
U19BTOE002 **INTRODUCTION TO BIOENERGY AND BIOFUELS**	**3**	**0**	**0**	**3**

Course Objectives

To enable the students

- This course will be focussed on achievement, acquisition of knowledge and enhancement of comprehension of information regarding bioenergy and biofuel technologies and their sustainable applications.

Course Outcomes

At the end of the course, learners will be able to

CO1. Understand in depth of the bioenergy and biofuels.

CO2. Distinguish various forms of bioenergy and biofuels production

CO3. Analyse concepts related to and advantages of bioenergy.

CO4. Develop novel products from biofuels.

CO5. Understand the environmental sustainability.

CO6. Understand the yield and efficiency of Biofuels

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3										2		
2	3	2													
3	3	3	3	2	2	2		1	3					2	
4	3	1	1			1		1						1	
5	3	3	2	1	2			1						1	
6	3	3	2	1	2			1						1	

3 - High, 2 - Medium, 1 – Low

UNIT I   **BASIC CONCEPTS OF BIO-FUELS**   **9**

Biopower, Bioheat, Biofuesl, advanced liquid fuels, drop-in fuels, biobased products

UNIT II   **FEEDSTOCKS**   **9**

Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and insdustrial waste.

UNIT III   **CONSERVATION TECHNOLOGIES**   **9**

Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV   **BIOMETHANE AND BIOHYDROGEN**   **9**

Biomethanol − Principles, materials and feedstocks, Process technologies and techniques, Advantages and limitations − Biological hydrogen production methods, Fermentative hydrogen production, Hydrogen economy − Advantages and limitations

UNIT V   **SUSTAINABILITY AND RESILIENCE**   **9**

Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels

TOTAL: 45 HOURS

TEXT BOOKS:

1. Biorenewable Resources – Engineering new products. Robert C Brown. Blackwell Publishing Professional, 2003.

OPEN ELECCTIVE - II

U19BTOE003	**ANALYTICAL METHODS AND INSTRUMENTATION**	**L** **T** **P** **C**
		3 **0** **0** **3**

Course Objectives:

- To inculcate the entrepreneurship spark among the student community by converting their research

ideas into commercial products
- To develop the entrepreneurial skill in the field of biotechnology
- To study the Business strategy and Technology Transfer

Course Outcomes:

At the end of the course, learners will be able to

CO1. Learn the different bio potential and its propagation.

CO2. get Familiarize the different electrode placement for various physiological recording

CO3. design bio amplifier for various physiological recording

CO4. understand various technique non electrical physiological measurements

CO5. Understand the different biochemical measurements

CO6. Characterize and analyze various macromolecules

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			2										2	
2	3	1	2	1		1							1	2	
3	3	2	3										1	1	
4	2	2	3											2	
5	2	2	3			3									
6	2	2													

3 - High, 2 - Medium, 1 – Low

UNIT I SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments-Sources of radiation – wavelength selectors – sample containers – radiation transducers -Signal process and read outs – signal to noise ratio – sources of noise – Enhancement of signal to noise – types of optical instruments – Applications.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beers law – Instrumentation – Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications -Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III NMR AND MASS SPECTROMETRY 9

Theory of NMR — chemical shift- NMR-spectrometers – applications of 1H and 13C NMR-Molecular mass spectra – ion sources. Mass spectrometer. Applications of molecular mass -Electron paramagnetic resonance- g values – instrumentation.

UNIT IV SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFAVE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry -Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch Instrumental Methods of Analysis.Cengage Learning , 2007
2. Willard, Hobart, etal., Instrumental Methods of Analysis. VIIth Edition, CBS, 1986
3. Haven, Mary C., etal., Laboratory Instrumentation .IVth Edition, John Wiley, 1995.

U19BTOE004	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:
- To emphasize on the importance of waste management in the industries

Course Outcomes:

At the end of the course, learners will be able to
- CO1. This course will make the students to design biological treatment units
- CO2. To undertake projects on biological wastewater treatment
- CO3. To design the treatment plants with fundamental understanding
- CO4. Be familiar with sampling of wastes.
- CO5. The students will undertake projects related to waste management.
- CO6. Understand various case studies related to waste management

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3										2		
2	3	2													
3	3	3	3	2	2	2		1	3					2	
4	3	1	1			1		1						1	
5	3	3	2	1	2			1						1	
6	3	3	2	1	2			1						1	

3 - High, 2 - Medium, 1 – Low

UNIT I   INTRODUCTION TO WASTE MANAGEMENT   9

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

UNIT II   CLEANER PRODUCTION   9

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

UNIT III   POLLUTION FROM MAJOR INDUSTRIES   9

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts

UNIT IV   REACTORS USED IN WASTE WATER TREATMENT   9

Theory: Modeling of Ideal Attached Growth Reactors, Bio-film Modeling Aerobic Growth of Biomass in PackedTowers, Aerobic Growth of Heterotrophs in Rotating Disc Reactors, Fluidized Bed Biological Reactors.

UNIT V   CASE STUDIES   9

Industrial manufacturing process description, Wastewater characteristics, Pollution Prevention Options and Treatment Flow sheets for selected Industries – Tanneries- Textiles- Pulp and PaperMetal finishing – Sugar and Distilleries.

                                                                                        TOTAL: 45 HOURS

TEXT BOOKS
1. Bhatia, Handbook of Industrial Pollution and Control, Volume I and II, CBS Publishers, New Delhi, 2003
2. Mahajan, S.P.Pollution Control in Process Industries, Tata McGraw Hill Publishing Co., New Delhi, 1991.

CIVIL ENGINEERING

OPEN ELECTIVE - I

U19CEOE001	GREEN BUILDINGS	L T P C
		3 0 0 3

APPROVED BY BOS CHAIRMAN

Course Objectives:

This course aims to provide the students,

- To imbibe basics of green design and sustainable development concept.
- To identify various area of implementing strategies for green design in projects to enhance built environment.
- To learn institutional guidelines for development and certification of green designs.

UNIT I INTRODUCTION 9

Green Building - Need for Green Building - Benefits of Green Buildings - Green Building Materials and Equipment in India - Key Requisites for Constructing a Green Building – Important Sustainable features for Green Building.

UNIT II GREEN BUILDING CONCEPTS AND PRACTISES 9

Indian Green Building Council - Green Building Moment in India - Benefits Experienced in Green Buildings - Launch of Green Building Rating Systems - Residential Sector – Market Transformation. Green Building Opportunities And Benefits: Opportunities of Green Building - Green Building Features, Material and Resources - Water Efficiency - Optimum Energy Efficiency - Typical Energy Saving Approach in Buildings - LEED India Rating System and Energy Efficiency.

UNIT III GREEN BUILDING DESIGN 9

Introduction - Reduction in Energy Demand - Onsite Sources and Sinks - Maximise System Efficiency - Steps to Reduce Energy Demand and Use Onsite Sources and Sinks - Use of Renewable Energy Sources. Eco-friendly captive power generation for factory - Building requirement.

UNIT IV UTILITY OF SOLAR ENERGY IN BUILDINGS 9

Utility of Solar energy in buildings. Concepts of Solar Passive Cooling and Heating of Buildings - Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V GREEN COMPOSITES FOR BUILDINGS 9 Concepts of Green Composites - Water Utilisation in Buildings - Low Energy Approaches to Water Management, Management of Solid Wastes, Management of Sullage Water and Sewage, Urban Environment and Green Buildings, Green Cover and Built Environment.

Total: 45 Hours

Course Outcomes:

At the end of the course, students should be able to

CO1 : Know about the importance and necessity of green buildings.

CO2 : Understand the principles of green building certifications (LEED) and low-energy building strategies.

CO3 : Understand the concepts and principles in Green Building Design.

CO4 : Suggest materials and technologies to improve energy efficiency of building.

CO5 : Gain ideas various green composites used in building and sustainable development.

CO6 : Have an Insight about criteria for rating systems along with established Indian codes an guideline.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-Moderate, 1-LOW												CO/PSO Mapping		
COs	PROGRAMME OUTCOMES (POs)												PSOs		
	PO	PO	PO	P	P	P	P	P	P	PO	PO	PO	PSO	PSO2	PSO3

	1	2	3	O4	O5	O6	O7	O8	O9	10	11	12	1		
CO1	1	-	2	1	3	-	3	-	-	-	-	2	2	1	3
CO2	2	1	3	2	1	2	3	-	-	-	-	1	2	1	3
CO3	2	2	2	3	1	1	3	-	-	-	-	3	2	1	3
CO4	-	-	1	-	-	-	3	-	-	-	-	2	2	1	3
CO5	2	-	1	2	1	-	3	-	-	-	-	3	3	1	3
CO6	3	2	1	2	-	1	3	-	-	-	-	1	3	3	3

Textbooks

T1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. "Alternative Building Materials and Technologies". New Age International, 2007.

T2. Low Energy Cooling for Sustainable Buildings. John Wiley and Sons Ltd, 2009.

T3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

Reference Books

R1. Osman Attmann, "Green Architecture Advanced Technologies and Materials". McGraw Hill, 2010.

R2. Jerry Yudelson, "Green building Through Integrated Design". McGraw Hill, 2009
Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke.

U19CEOE002	**DISASTER PREPARDNESS AND MANAGEMENT**	**L T P C**
		3 0 0 3

Course Objectives:

This course aims to provide the students,

- To Understand the basic concepts of disaster management.
- To acquire knowledge on types and categories of disasters.

• To understand the impacts and challenges posed by disasters.

UNIT I   **INTRODUCTION TO DISASTER**   **9**

Concepts and definitions - disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation. Global trends in disasters - urban disasters, pandemics, complex emergencies, Climate change. Disaster's classification - natural disasters - manmade disasters - hazard and vulnerability profile of India - mountain and coastal areas, ecological fragility. Dos and Don'ts during various types of Disasters.

UNIT II   **DISASTER IMPACTS**   **9**

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.) - health, psycho, social issues - demographic aspects (gender, age, special needs) - hazard locations - global and national disaster trends - climate change and urban disasters.

UNIT III   **DISASTER RISK REDUCTION**   **9**

Disaster management cycle – its phases : prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures - risk analysis - vulnerability and capacity assessment - early warning systems - Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications) - Roles and responsibilities of government – community - local institutions - NGOs and other stakeholders - Policies and legislation for disaster risk reduction - DRR programmes in India and the activities of National Disaster Management Authority

UNIT IV   **DISASTER RISK MANAGEMENT IN INDIA**   **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V   **DISASTERS, ENVIRONMENT AND DEVELOPMENT**   **9**

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmentally friendly recovery; reconstruction and development methods.

                                                            Total: 45 Hours

Course Outcomes:

At the end of the course, students should be able to,

 CO1 : Understand the foundations of hazards, disasters and associated natural/social phenomena.

 CO2 : Familiarity with disaster management theory (cycle, phases) and Methods of community involvement as an essential part of successful DRR.

 CO3 : Apply knowledge about existing global frameworks and existing agreements.

 CO4 : Understand consequences and inter relationship between development and disasters.

 CO5 : Draw the hazard and vulnerability profile of India, Scenarios in the Indian context.

 CO6 : Conduct independent DM study including data search, analysis and presentation of disaster case study.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW		CO/PSO Mapping
CO	**PROGRAMME OUTCOMES (POs)**	**PSOs**

s	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	2	1	-	1	1	3	3	-	-	1	-	2	3	1	1
CO2	-	2	1	1	2	2	3	-	3	-	-	2	2	1	-
CO3	-	3	2	1	-	3	1	-	3	-	-	2	2	1	-
CO4	3	3	-	1	3	3	2	-	-	-	-	2	3	1	-
CO5	-	3	2	1	3	3	2	-	-	3	-	2	3	1	3
CO6	3	3	2	-	1	3	2	-	-	-	-	-	2	1	3

Textbooks:

T1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010.

T2. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.

T3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.

Reference Books:

R1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.

R2. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

R3. Government of India, National Disaster Management Policy,2009.

OPEN ELECTIVE – II

U19CEOE003	REMOTE SENSING AND GIS	L T P C
		3 0 0 3

Course Objectives:

This course aims to provide the students,

- Understanding about the basic concepts of remote sensing and analyse satellite imagery and extract the required units.
- Usage of thematic maps for various applications.

UNIT I   REMOTE SENSING   9

Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False colour composite, elements of visual interpretation techniques.

UNIT II   REMOTE SENSING PLATFORMS AND SENSORS   9

Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms – IRS, sensors, sensor resolutions, Basics of digital image processing - introduction to digital data, systematic errors and non-systematic errors, Image enhancements, image filtering.

UNIT III   GEOGRAPHIC INFORMATION SYSTEM   9

Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute Data - Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.

UNIT IV   DATA MODELS   9

Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion.

UNIT V   INTEGRATED APPLICATIONS OF REMOTE SENSING AND GIS   9

Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services and Its Applications.

Total: 45 Hours

Course Outcomes:

At the end of the course, students should be able to,

CO1 : Analyse the principles and components of photogrammetry and remote sensing.
CO2 : Gain knowledge on various types of sensors and platforms for satellites.
CO3 : Process of data acquisition of satellite images and their characteristics
CO4 : Analyse an image visually and digitally with digital image processing techniques.
CO5 : Explain the concepts and fundamentals of GIS.
CO6 : Apply the knowledge of remote sensing and GIS in different civil engineering filed.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW		CO/PSO Mapping
CO s	**PROGRAMME OUTCOMES (POs)**	**PSOs**

	PO 1	PO 2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	-	-	2	3	-	-	-	-	-	-	3	2	2	2
CO2	3	2	-	2	3	-	-	-	-	2	-	3	2	2	3
CO3	3	-	1	3	3	2	1	-	-	-	-	3	2	2	1
CO4	3	2	-	3	3	-	2	-	-	-	-	3	2	2	1
CO5	3	-	-	1	3	-	-	-	-	2	-	3	2	2	1
CO6	3	3	1	3	3	2	2	-	-	3	-	3	2	2	1

Textbooks:

T1. Anji Reddy M., "Remote sensing and Geographical information system", B.S. Publications 2008.

T2. Narayan Panigrahi, "Geographical Information Science", and University Press 2008.

T3. Basudeb Bhatta, "Remote sensing and GIS", Oxford University Press 2011

Reference Books:

R1. Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006

R2. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004.

R3. S Kumar, "Basics of remote sensing & GIS", Laxmi publications 2005.

U19CEOE004   **AIR POLLUTION AND CONTROL ENGINEEIRNG**   **L T P C**
                                                                         3 0 0 3

Course Objectives:

This course aims to provide the students,

• Knowledge on the principle and design of control of Indoor/ particulate / gaseous air pollutant and its emerging trends.

UNIT I   **INTRODUCTION**   **9**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards

UNIT II   **METEROLOGY**   **9**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns - Atmospheric Diffusion Theories – Dispersion models, Plume rise

UNIT III   **CONTROL OF PARTICULATE CONTAMINANTS**   **9**

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV   **CONTROL OF GASEOUS CONTAMINANTS**   **9**

Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

UNIT V   **INDOOR AIR QAULITY MANAGEMENT**   **9**

Sources, types and control of indoor air pollutants, sick building syndrome and building related illness Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

                                                              Total: 45 Hours

Course Outcomes:

At the end of the course, students should be able to,

CO1 : Understanding of the nature and characteristics of air pollutants and basic concepts of air quality management.

CO2 : Understand the type and nature of air pollutants, the behaviour of plumes and relevant meteorological determinants influencing the dispersion of air pollutants.

CO3 : Ability to identify, formulate and solve air and noise pollution problems.

CO4 : Ability to design stacks and particulate air pollution control devices to meet applicable standards.

CO5 : Ability to select control equipment's.

CO6 : Ability to ensure quality, control and preventive measures.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW	CO/PSO Mapping
CO s **PROGRAMME OUTCOMES (POs)**	**PSOs**

	PO 1	PO 2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	2	3	3	1	2	3	3	-	1	-	-	3	2	-	1
CO2	3	2	2	-	3	1	3	-	-	-	-	2	2	1	1
CO3	2	3	2	-	-	3	3	-	-	-	-	2	3	1	-
CO4	2	2	-	-	-	3	3	-	1	-	-	2	3	1	1
CO5	1	1	-	-	3	3	3	-	1	-	-	1	2	-	-
CO6	2	2	-	-	3	3	3	-	-	-	-	2	3	-	1

Textbooks:

T1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science media LLC,2004.

T2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press, Inc 2017.

T3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

Reference Books:

R1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.

R2. Arthur C. Stern, "Air Pollution (Vol. I – Vol. VIII)", Academic Press, 2006.

R3. Wayne T. Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.

COMPUTER SCIENCE AND ENGINEERING

OPEN ELECTIVE – I

U19CSOE001   **SOFTWARE ENGINEERING**   L   T   P   C
                                                                             3   0   0   3

Course Objectives:

To understand the phases in a software project

• To understand fundamental concepts of requirements engineering and Analysis Modeling.
• To understand the various software design methodologies
• To learn various testing and maintenance measures•

Course Articulation Matrix : 3- High, 2- Medium, 3- Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1											2	2
CO2	2	1	1											2	2
CO3	3	2	2											2	2
CO4	3	2	2											2	2
CO5	3	2	2											2	2
CO6	3	2	2											2	2

UNIT I   SOFTWARE PROCESS AND AGILE DEVELOPMENT   9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile process-Extreme programming-XP Process.

UNIT II   REQUIREMENTS ANALYSIS AND SPECIFICATION   9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III   SOFTWARE DESIGN   9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components..

UNIT IV   TESTING AND MAINTENANCE   9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering..

UNIT V   PROJECT MANAGEMENT   9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

Total: 45HOURS

Course Outcomes:

At the end of the course students should be able to

CO1   Identify the key activities in managing a software project and recognize different process model
CO2   Explain the concepts of requirements engineering and Analysis Modeling.
CO3   Outline the systematic procedures for software design and deployment

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CO4   Compare various testing and maintenance methods
CO5   Interpret the project schedule, estimate project cost and effort required.
CO6   Develop a software using the software engineering principles

TEXT BOOKS:
   T1:   Roger S. Pressman, "Software Engineering – A Practitioner"s Approach", Seventh Edition, Mc Graw-Hill International Edition, 2010..
   T2:   Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:
   R1:   Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009
   R2:   Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
   R3:   Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
   R4:   Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited, 2007.

	L	**T**	**P**	**C**
U19CSOE002 **DATABASE MANAGEMENT SYSTEMS**	3	0	0	3

Course Objectives:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

PREREQUISITES: NIL

Course Articulation Matrix : 3- High, 2- Medium, 3- Low															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1											2	2
CO2	3	2	2											3	3
CO3	2	1	1											2	2
CO4	2	1	1											2	2
CO5	2	1	1											3	3
CO6	2	1	1											2	2

UNIT I   RELATIONAL DATABASES   10

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

UNIT II   DATABASE DESIGN   8

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III   TRANSACTIONS   9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery

UNIT IV   TESTING AND MAINTENANCE   9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V   PROJECT MANAGEMENT   9

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to

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CO1	Discuss the fundamental concepts of relational database and SQL
CO2	Use ER model for Relational model mapping to perform database design effectively
CO3	Summarize the properties of transactions and concurrency control mechanisms
CO4	Outline the various storage and optimization techniques
CO5	Compare and contrast various indexing strategies in different database systems
CO6	Explain the different advanced databases

TEXT BOOKS:

T1: Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011.

T2: Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2011.

REFERENCE BOOKS:

R1: C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

R2: Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

R3: G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.

OPEN ELECTIVE – II

APPROVED BY BOS CHAIRMAN

U19CSOE003   **DATA STRUCTURES AND ALGORITHMS**   **L   T   P   C**
                                                                     3   0   0   3

Course Objectives:
- Understand the various algorithm design and analysis techniques
- To learn linear data structures – lists, stacks, and queues
- To learn different sorting and searching algorithms
- To understand Tree and Graph data structures

PREREQUISITES: NIL

Course Articulation Matrix : 3- High, 2- Medium, 3- Low														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	–	–	–	–	–	–	–	–	–	–	–	–	–	
CO2	3	–	–	–	–	–	–	–	–	–	–	–	–	–	
CO3	3	2	2	2	–	–	–	–	–	–	–	–	–	-	-
CO4	3	2	2	2	–	–	–	–	–	–	–	–	–	–	
CO5	3	3	2	2	–	–	–	–	–	–	–	–	–	1	1
CO6	2	3	2	1										1	1

UNIT I   ALGORITHM ANALYSIS, LIST ADT   11

Algorithms: Notation - analysis – running time calculations. Abstract Data Types (ADTs): List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.

UNIT II   STACKS AND QUEUES   7

Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.

UNIT III   SEARCHING AND SORTING ALGORITHMS   10

Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.

UNIT IV   TREES   9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Heap – applications of heap. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C. Implementation of heap and heap sorting using arrays in C.

UNIT V   GRAPHS   8

Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Dynamic programming Technique – Warshall's and Floyd's algorithm – Greedy method - Dijkstra's algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra's algorithm in C

Total: 45 HOURS

Course Outcomes:
     At the end of the course students should be able to

CO1 Define data structures like array, stack, queues and linked list.

CO2 Explain insertion, deletion and traversing operations on data structures.

CO3 Identify the asymptotic notations to find the complexity of an algorithm.

CO4 Compare various searching and sorting techniques.

CO5 Choose appropriate data structure while designing the algorithms.

CO6 Design advance data structures using non linear data structures.

TEXT BOOKS:

T1: Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,1997..

T2: Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson Education, 1988.

REFERENCE BOOKS:

R1: Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education,1983

R2: S.Sridhar, "Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014

R3: Byron Gottfried, Jitender Chhabra, "Programming with C" (Schaum's Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010

R4: Yashvant Kanetkar, "Data Structures Through C", BPB publications, II edition, 2003

ELECTRICAL AND ELECTRONICS ENGINEERING

APPROVED BY BOS CHAIRMAN

UNIT EOE001   **RENEWABLE ENERGY RESOURCES GENERATION**   **L T P C**

                                                                               3 0 0 3

COURSE OBJECTIVES

- To get exposure on renewable energy source.
- To know about the solar radiation and its environmental impact to power.
- To learn about the wind energy and its economic aspects.
- To know about geothermal energy with other energy sources.
- To get exposure on distributed generation in storage systems

PREREQUISITES

- Fundamentals of electrical engineering
- Basic concepts of Differentiation

	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping			
	PROGRAMME OUTCOMES (POs)												PSOs			
Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3	PSO4
CO1	3	-	2	2	-	1	3	-	-	-	2	-	3	3	2	2
CO2	3	-	2	2	-	1	3	-	-	-	2	-	2	2	2	2
CO3	3	-	2	2	-	1	3	-	-	-	2	-	2	3	3	1
CO4	3	-	2	2	-	1	3	-	-	-	2	-	1	2	2	2
CO5	3	-	2	2	-	1	3	-	-	-	2	-	2	2	2	2
CO6	3	-	2	2	-	1	3	-	-	-	2	-	3	2	2	2

UNIT I   **INTRODUCTION**   **9**

Energy scenario: National and International – Energy resources and their availability – Conventional power generation plant (Thermal power plant) - Environmental aspects of fossil fuels – Necessity for renewable energy sources – Types of renewable energy source and its limitation.

UNIT II   **SOLAR PHOTOVOLTAIC SYSTEM**   **9**

Introduction – Solar radiation and measurements – Basic principle of SPV conversion – Solar energy collectors – Solar energy storage: Solar pond – Types of solar PV cells – PV cell connections – Characteristics of PV module and its parameters - Application of solar energy: Solar pumping and solar cooking.

UNIT III   **WIND ENERGY SYSTEM**   **9**

Introduction – Wind energy conversion – Power produced from wind - Relationship between wind speed and power – Components of wind power plant (WPP) – Types of WPP – Selection of site for WPP – Advantages and challenges of WPP.

UNIT IV   **ENERGY FROM OTHER SOURCES**   **9**

Geothermal energy (GTE): operation of GTE power plants - Types– Advantage of GTE- Tidal energy: Operation of tidal power plant – Ocean Thermal Energy Conversion system: Open and closed cycles - Fuel cell: Construction and working principle- Advantage and applications of Fuel cell.

Concept of DG – Benefits of DG – Types of DG resources – Security issues in integrating DG with power grid - Energy storage elements: Batteries, super-capacitors, flywheels - Captive power plants

Total: 45 HOURS

Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO1 Acquire knowledge on power demand scenario of world and the importance of renewable energy sources in meeting the power demand

CO2 Understand the working principle of solar photovoltaic system and its applications

CO3 Outline the various components and performance of wind energy conversion system

CO4 Explain the operation of geothermal and tidal power plants, fuel cell and ocean thermal energy conversion scheme.

CO5 Understand the necessity of distributed generation and energy storage elements.

CO6 Understand about the power generation through renewable energy sources

TEXT BOOKS:

T1: Rai, G.D., "Non-Conventional Energy Sources", Khanna Publishers, Sixth Edition 2017

T2: Khan, B.H, Non-Conventional Energy Resources", Mc. Graw Hill Education Ltd, third reprint 2017.

REFERENCE BOOKS:

R1: Rao S. Paruklekar,B.B, "Energy Technology –Non Conventional, Renewable and Conventional", KhannaPublishers,1994

R2: John Twidell and Tony Weir, "Renewable Energy Resources", Tyalor and Francis Publications, Third edition, 2015.

U19EEOE002	INTRODUCTION TO CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

APPROVED BY BOS CHAIRMAN

COURSE OBJECTIVES

1. To understand the concepts of control systems-open loop and closed loop control systems.
2. To understand the (mathematical modelling) Transfer function from mechanical, electrical, block diagram and signal flow graph.
3. To learn the concepts of steady state and transient responses from first and second order systems at different inputs and also steady state errors.
4. To learn the stability concepts are Root locus, Bode plot and Polar plot
5. To learn the concept of state space analysis applying on multi-input/output state of the system to find the stability.

PREREQUISITES

- Basic concepts of circuit analysis
- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration

UNIT I   INTRODUCTION   9

Concepts of control systems-open loop and closed loop control systems and their differences-different examples of control systems-classification of control systems, feed-back characteristics, effects of feedback. Mathematical models-differential equations, impulse response and transfer functions.

UNIT II   TRANSFER FUNCTION REPRESENTATION   9

Block diagram representation of systems considering electrical systems as examples-block diagram algebra-representation by signal flow graph-reduction using mason's gain formula.

UNIT III   TIME RESPONSE ANALYSIS   9

Standard test signals-time response of first order systems- characteristic equation of feedback control systems, transient response of second order systems-time domain specifications-steady state response-steady state errors and error constants-effects of proportional derivative, proportional integral systems, PID controllers

UNIT IV   STABILITY AND FREQUENCY RESPONSE ANALYSIS   9

The concept of stability-routh's stability criterion- The root locus concept –construction of root loci-effects of adding poles and zeros to G(S) H(S) on the root loci - Frequency domain specifications - bode diagrams-determination of frequency domain specifications and transfer function from the bode diagram-phase margin and gain margin-stability analysis from bode plots. Polar plots.

UNIT V   STATE SPACE ANALYSIS   9

Concepts of state, state variables and state model, derivation of state models from block diagrams, diagonalization-solving the time invariant state equations-state transition matrix and it's properties-concepts of controllability and observability.

Total: 45 HOURS

Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO1	Ability to find the Mathematical models-differential equations, impulse response and transfer functions.
CO2	Ability to find the transfer function from mechanical, electrical, block diagram, signal flow graph and electronic system
CO3	Describe the concept of steady state and transient response at different inputs
CO4	Apply the concepts of stability in s-domain and Routh criteria and the concepts of plotting the response of a system on a graph
CO5	Design and implement any system using state space analysis
CO6	Ability to implement the real time applications of control system

TEXT BOOKS:

> **T1:**   C. Kuo, Automatic Control Systems, 8th edition, John Wiley and sons, India, 2003

T2: J. Nagrath, M. Gopal, Control Systems Engineering, 2nd edition, New Age International (P) Limited, New Delhi.

REFERENCE BOOKS:

R1: Katsuhiko Ogata, Modern Control Engineering, 3rd edition, Prentice Hall of India Pvt. Ltd., India, 1998

R2: Norman S. Nice, Control Systems Engineering, 6th edition, John Wiley, India, 2015

R3: N. K. Sinha(1998), Control Systems, 3rd edition, New Age International (P) Limited Publishers, India.

U19EEOE003 **SENSORS AND TRANSDUCERS** **L T P C**

3 0 0 3

Course Objectives:
- To understand the concepts of measurement technology
- To learn the various sensors used to measure various physical parameters
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

COs	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping			
	PROGRAMME OUTCOMES (POs)												PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	-	3	-	3	2	-	-	2	-	2	-	2	2	2	2
CO2	2	-	3	-	3	2	-	-	2	-	2	-	3	2	2	2
CO3	2	-	3	-	3	2	-	-	2	-	2	-	2	3	3	3
CO4	2	-	3	-	3	2	-	-	2	-	2	-	3	2	2	2
CO5	2	-	3	-	3	2	-	-	2	-	2	-	2	2	2	3
CO6	2	-	3	-	3	2	-	-	2	-	2	-	3	2	1	3

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques –Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Total: 45 HOURS

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Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO 1   Expertise in various calibration techniques and signal types for sensors.

CO 2   Understand about the various sensors

CO3   Apply the various sensors in the Automotive and Mechatronics applications

CO4   Study the basic principles of various smart sensors.

CO5   Implement the DAQ systems with different sensors for real time applications

CO6   Understand about different sensors with applications

TEXT BOOKS:

T1: Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.

T2: Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

R1: Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

R2: John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999

R3: Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press,2015.

U19EEOE004 **ENERGY TECHNOLOGY**

L   T   P   C
3   0   0   3

COURSE OBJECTIVES

- Students will gain knowledge about different energy scenario
- To understand about the conventional energy sources.
- To understand about the non-conventional energy sources.
- To understand about the biomass energy sources.
- To learn the concept of energy conservation

	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping			
	PROGRAMME OUTCOMES (POs)												**PSOs**			
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	3	-	3	-	2	-	2	-	2	-	2	2	2	2
CO2	2	1	3	-	3	-	2	-	2	-	2	-	2	2	2	2
CO3	2	1	3	-	3	-	2	-	2	-	2	-	2	3	3	3
CO4	2	1	3	-	3	-	2	-	2	-	2	-	3	2	3	2
CO5	2	1	3	-	3	-	2	-	2	-	2	-	2	3	2	3
CO6	2	1	3	-	3	-	2	-	2	-	2	-	3	2	1	3

PREREQUISITES

- Fundamentals of electrical engineering
- Basic concepts of Differentiation
- Basic concepts of Integration

UNIT I   ENERGY   **9**

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II   CONVENTIONAL ENERGY   **9**

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants

UNIT III   NON-CONVENTIONAL ENERGY   **9**

Solar energy, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, energy plantations. Wind energy, types of windmills, types of wind rotors, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV   BIOMASS ENERGY   **9**

Biomass origin - Resources – Biomass estimation. Thermo chemical conversion – Biological conversion,– Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V   ENERGY CONSERVATION   **9**

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

Total: 45 HOURS

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Course Outcomes:

Upon successful completion of this course, the student will be able to:

CO1   Understand energy scenario in India

CO2   Understand conventional Energy sources,

CO3   Understand Non- conventional Energy sources,

CO4   Understand biomass sources and develop design parameters for equipment to be used in Chemical process industries

CO5   Understand energy conservation in process industries

CO6   Understand about different energy technology

TEXT BOOKS:

T1:   Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.

T2:   Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.

T3: Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCE BOOKS:

R1:   Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.

R2:   Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008

R3:   El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.

ELECTRONICS AND COMMUNICATION ENGINEERING

OPEN ELECTIVE – I

U19ECOE001   **SOFT COMPUTING**   **L T P C**

                                                                3 0 0 3

Course Objectives:
- **T**o learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems

CO s	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW PROGRAMME OUTCOMES (POs)												CO/PSO Mapping PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2							2	1	3	3	1
CO2	3	2	2	2							2	1	3	3	1
CO3	3	2	2	2							2	1	3	3	1
CO4	3	2	2	2							2	1	3	3	1
CO5	3	2	2	2							2	1	3	3	1
CO6	3	2	2	2							2	1	3	3	1

PREREQUISITES
- Basic concepts of communication theory
- Basics of Computer Networks

UNIT I   INTRODUCTION TO SOFT COMPUTING   9

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron -Adaline &Madaline Network.

UNIT II   ARTIFICIAL NEURAL NETWORKS   9

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT III   FUZZY SYSTEMS   9

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV   GENETIC ALGORITHMS   9

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT V   HYBRID SYSTEMS   9

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

Total: 45 HOURS

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Course Outcomes:

At the end of the course students should be able to

CO102.1:   Apply suitable neural computing techniques for various applications.

CO102.2:   Explain various ANN models

CO102.3:   Apply fuzzy concepts for various applications

CO102.4:   Apply genetic algorithms to solve problems

CO102.5:   Integrate various soft computing techniques for complex problems.

CO102.6:   Apply neural techniques for various applications

TEXT BOOKS:

T1:   N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

T2:   S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.

T3:   S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCE BOOKS:

R1:   Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.

R2:   Kwang H.Lee, —First course on Fuzzy Theory and Applications‖, Springer, 2005

R3:   George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.

U19ECOE002	MEDICAL ELECTRONICS	L	P	C
		3	0	3

COURSE OBJECTIVES

- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques

CO/PO MAPPING (S/M/W indicates strength of correlation)														CO/PSO		
3-HIGH, 2-MEDIUM, 1-LOW														Mapping		
	PROGRAMME OUTCOMES (POs)													PSOs		
CO s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2							2	1	3	3	1
CO2	3	2	2	2							2	1	3	3	1
CO3	3	2	2	2							2	1	3	3	1
CO4	3	2	2	2							2	1	3	3	1
CO5	3	2	2	2							2	1	3	3	1
CO6	3	2	2	2							2	1	3	3	1

PREREQUISITES

- Basic Electronics
- Electronic devices

UNIT I   ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING   9

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II   NON ELECTRICAL PARAMETER MEASUREMENTS   9

Blood flow meter-Types, Cardiac output measurements-Types, respiratory measurement, blood pressure measurement, temperature and pulse measurement, Blood Cell Counters

UNIT III   THERAPEUTIC EQUIPMENTS   9

Cardiac pacemakers - types, Cardiac defibrillators-types, Dialyzers, Heart Lung Machines –Oxygenations, Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy

UNIT IV   MEDICAL IMAGING   9

X-Ray machine, computer axial tomography- CT scans, Positron Emission Tomography- PET Scans. MRI and NMR Ultrasonic Imaging systems, Medical Thermograph

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION AND APPLICATION IN MEDICINE 9

Bio medical telemetry- remote patient monitoring systems, Telemedicine, Radio pill, Application of cryogenics in medicine, Application of LASERS in medicines. Diagnosis of Cancers and tumors using image processing, diagnosis of dental plague using image processing, diagnosis of various eye problems using image processing

Total: 45 HOURS

COURSE OUTCOMES

At the end of the course students should be able to

CO102.1: Know the human body electro- physiological parameters and recording of bio-potentials

CO102.2: Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.

CO102.3: Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators

CO102.4: Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies , and bio-telemetry principles and methods

CO102.5: Know about recent trends in medical instrumentation

CO102.5: Implement application of Instruments

TEXT BOOKS:

T1: Leslie Cromwell, Biomedical Instrumentation and Measurement‖, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)

T2: Khandpur, R.S., -Handbook of Biomedical Instrumentation‖, TATA McGraw-Hill, New Delhi, 2003.(UNIT I – V)

REFERENCE BOOKS:

R1: Dhake .A.M, " Television and Video Engineering", Mc graw Hill, New Delhi, India, 2006

R2: Modern television practice: Transmission, reception and applications, New age International, New Delhi, 2015

U19ECOE003   **CONSUMER ELECTRONICS**   **L T P C**

                                                                        3 0 0 3

COURSE OBJECTIVES

- .Understand troubleshooting in loudspeakers and Microphones
- Gain knowledge on television signals and components
- Gain knowledge on various types of audio recording and playback techniques
- Understand communication systems
- Understand principle of working of home appliances

CO/PO MAPPING (S/M/W indicates strength of correlation)													CO/PSO Mapping		
3-HIGH, 2-MEDIUM, 1-LOW															
CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2							2	1	3	3	1
CO2	3	2	2	2							2	1	3	3	1
CO3	3	2	2	2							2	1	3	3	1
CO4	3	2	2	2							2	1	3	3	1
CO5	3	2	2	2							2	1	3	3	1
CO6	3	2	2	2							2	1	3	3	1

PREREQUISITES

- Basic Electronics
- Electronic devices

UNIT I   LOUDSPEAKERS AND MICROPHONES   9

Dynamic Loudspeaker, Electrostatic loudspeaker, Permanent Magnet Loudspeaker, Woofers and Tweeters - Microphone Characteristics, Carbon Microphones, Dynamic Microphones and Wireless Microphones

UNIT II   TELEVISION STANDARDS AND SYSTEMS   9

Components of a TV system – interlacing – composite video signal. Colour TV – Luminance and Chrominance signal; Monochrome and Colour Picture Tubes - Colour TV systems – NTSC, PAL,SECAM - Components of a Remote Control.

UNIT III   OPTICAL RECORDING AND REPRODUCTION   9

– Audio Disc – Processing of the Audio signal – read out from the Disc –Reconstruction of the audio signal – Video Disc – Video disc formats- recording systems – Playback Systems.

UNIT IV   TELECOMMUNICATION SYSTEMS   9

Telephone services - telephone networks – switching system principles –PAPX switching – Circuit, packet and message switching, LAN, MAN and WAN, Integrated Services Digital Network. Wireless Local Loop. VHF/UHF radio systems, Limited range Cordless Phones; cellular modems

UNIT V   HOME APPLIANCES   9

Basic principle and block diagram of microwave oven; washing machine hardware and software; components of air conditioning and refrigeration systems

                                                                    Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to

CO102.1: Troubleshoot different types of microphones and speakers

CO102.2: Maintain audio systems

CO102.3: Analyse composite video signal used in TV transmission

CO102.4: Troubleshoot TV Receivers

CO102.5: Construct various home appliances

CO102.6: Maintain various home appliances

TEXT BOOKS:

T1: S.P.Bali, "Consumer Electronics", Pearson Education, 2005.

T2: Gupta. R.G, " Audio Video Systems principles maintenance and trouble shooting, Mc graw Hill, New Delhi, India, 2010

REFERENCE BOOKS:

R1: Dhake .A.M, " Television and Video Engineering", Mc graw Hill, New Delhi, India, 2006

R2: Modern television practice: Transmission, reception and applications, New age International, New Delhi, 2015

U19ECOE004　　　　**ADVANCED WIRELESS COMMUNICATION**　　　　**L　T　P　C**

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　3

Course Objectives:

- To expose the students to the importance of improving capacity of wireless channel using MIMO
- To enable understanding of channel impairment mitigation using space-time block and Trellis codes
- To teach advanced MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems

CO s	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW			

| CO s | \multicolumn{12}{c}{PROGRAMME OUTCOMES (POs)} | | \multicolumn{2}{c}{PSOs} | |

CO s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
CO1	3	2	2	2							2	1	3	3	
CO2	3	2	2	2							2	1	3	3	
CO3	3	2	2	2							2	1	3	3	
CO4	3	2	2	2							2	1	3	3	
CO5	3	2	2	2							2	1	3	3	
CO6	3	2	2	2							2	1	3	3	

PREREQUISITES

- Basic concepts of communication theory
- Basics of Computer Networks
- Limits and Continuity
- Basic concepts of Differentiation
- Basic concepts of Integration

UNIT I　　　　CAPACITY OF WIRELESS CHANNELS　　　　9

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

UNIT II　　　　RADIO WAVE PROPAGATION　　　　9

Radio wave propagation – Macroscopic fading- free space and out door, small scale fading Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Diversity combining methods

UNIT III　　　　SPACE TIME BLOCK CODES　　　　9

Delay Diversity scheme, Alamoti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.

UNIT IV　　　　SPACE TIME TRELLIS CODES　　　　9

Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

UNIT V　　　　LAYERED SPACE TIME CODES　　　　9

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　Total: 45 HOURS

Course Outcomes:

At the end of the course students should be able to

CO102.1:   Comprehend and appreciate the significance and role of this course in the present contemporary world

CO102.2:   Apply the knowledge about the importance of MIMO in today's communication

CO102.3:   Appreciate the various methods for improving the data rate of wireless systems

CO102.4:   Explain the working of layered space time transmitter and receiver

CO102.5:   Describe various radio propagation techniques

CO102.6:   Explain various MIMO systems

TEXT BOOKS:

T1:   Mohinder Jankiraman, Space-time codes and MIMO systems, Artech House, Boston, London . www.artech house.com, ISBN 1-58053-865-7-2004

T2:   Paulraj Rohit Nabar, Dhananjay Gore, Introduction of space time wireless communication systems, Cambridge University Press, 2003.

REFERENCE BOOKS:

R1:   David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication‖, Cambridge University Press, 2005.

R2:   Sergio Verdu ― Multi User Detection‖ Cambridge University Press, 1998

ENGLISH

OPEN ELECTIVE – I

U19ENOE01	**ENGLISH for COMPETITIVE EXAMS** (Common to ALL)	**L T P C** 3 0 0 3

Course Objectives:
- To prepare learners to face the challenges of regular/online competitive exams I the English language globally.
- To enable students to prepare for competitive exams of various kinds especially meant for testing ability in the English language.
- To introduce students to the common question types asked in competitive examinations concerning English- grammar, vocabulary, comprehension, and other significant topics.
- To help the students to overcome the fear of English as a compulsory subject in various competitive exams.
- To encourage students to appear and prepare for the competitive exams

CO/PO MAPPING														CO/PSO Mapping		
COs	**PROGRAMME OUTCOMES (POs)**													**PSOs**		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3
CO1							2	2	2	3		2			2
CO2								1	2	3		2			2
CO3						2		2	3	3		2			2
CO4							3	2	1	3		3			3
CO5						3	3	3	3	3		3			3

3 – HIGH; 2 –MEDIUM; 1- LOW.

PRE-REQUISITES: Nil

UNIT I 9

Types of Sentences – Sentence correction –Sentence sequence –Word Reordering - Data Interpretation: Tree Diagram, Flow Chart, Table, Line Graph – Discourse Markers – Identifying the exams interested to appear for - Online Course: Udemy, Edx, Future Learn

UNIT II 9

Reading Comprehension: Focus on different levels of Comprehension- Literal, Inferential, Analytical, and Critical reasoning – Identifying keywords and signal words, decoding the building blocks of a passage, understanding the jargon and double distractors – Error Spotting Rules – Identification Common Errors

UNIT III 9

Listening Comprehension: Micro skills and Macro skills of Listening – Idioms and Phrases- Homonyms and Homophones – Collocations- Synonyms and Antonyms: Banking, Indian Constitution, Education, Corporate, and Higher Education - Para jumbles

UNIT IV 9

Speaking: Presentation and Public: Record of videos – Verbal Ability; Sentence Completion, and Verbal analogies –Confirmation of registering for competitive exams.

UNIT V 9

Speech Project – Time Management – Stress Management –Standard Assessment: 5 Mock Tests

Total: 45 HOURS

Course Outcome:

At the end of the course, students should be able to

CO1	Confidently use the English language at an advanced level sharing their points of view with effective conclusions.
CO2	Construct correct sentences with the advanced vocabulary of the fields like Banking, Indian polity, Education, Corporate, etc.
CO3	Read accurately using contextual, analytical thinking and logical thinking skills
CO4	Aware of the opportunities available in the government and private sectors
CO5	Demonstrate excellent Time Management skills with regard to various competitive exam patterns

TEXT BOOKS

T1	Richards, C. Jack. Interchange Students Book-3 New Delhi: CUP, 2015.
T2	Means,L. Thomas and Elaine Langlois. English and Communication For Colleges. Cengage Learning, USA: 2007.
T3	The Official Guide to the GRE General Test, Third Edition (TEST PREP)by Educational Testing Service	16 February 2017
T4	The Yearly Current Affairs 2022 for Competitive Exams (Upsc, State Psc, Ssc, Bank Po/ Clerk, Bba, MBA, Rrb, Nda, Cds, Capf, Crpf), Disha Publication, Genre: General, ISBN: 9789355640888

REFERENCE BOOKS

R1	Brians, Paul. (2013). Common errors in English usage: Third edition. Wilsonville:Franklin,Beedle& AssociatesInc
R2	Harrison, Louis. (2009). Achieve IELTS grammar and vocabulary: English forinternationaleducation. London: Cengage LearningEMEA.
R3	Khashoggi, K.,&Astuni.A. (2014)SATreadingcomprehension workbook:Advancedpracticeseries. New York:IlexPublications.
R4	Prasad, Hari Mohan.(2013). Objective English for competitive exams.New Delhi:TataMcGraw-Hill EducationIndia.
R5	Seely, John. (2013). Oxford guide to effective writing and speaking: How tocommunicateclearly. Oxford: Oxford UniversityPress.

WEB RESOURCES

W1	https://www.edubull.com/exams/competitive-exams
W2	https://sscstudy.com/
W3	https://examsdaily.in/important-study-materials-pdf
W4	http://www.recruitmenttopper.com/study-material-for-all-competitive-exams/

OPEN ELECTIVE – II

U19ENOE02	**ENGLISH for EMPLOYABILITY SKILLS** **(Common to ALL)**	**L T P C** 3 0 0 3

COURSE OBJECTIVES

- To hone the employability-related communication skills of the students on the foundations built during Executive
- To assist students in becoming well-versed, responsible, creative communicators.
- To develop students' knowledge of communication skills in the structure, elucidation, and delivery of messages in diverse cultural and global communities; and
- To promote theoretical understanding and professional/personal practice of effective and ethical human communication between and within a broad range of contexts and communities.
- To write responses appropriately, organize ideas, and use vocabulary accurately

PRE-REQUISITES: Nil

UNIT I   **9**

SWOT Analysis – Perception Management – Positive Attitude – Empathy – Altruism – Self Management - Etiquette: Social, Dinner, Corporate, Telephone and Netiquette – Interview Skills

UNIT II   **9**

Reading Comprehension: Technical passages –Kinds of sentences –Sentence correction – Error spotting – Idioms – Vocabulary: Jargon and Distractors – Punctuation errors – Online Course: Udemy, Edx, FutureLearn

UNIT III   **9**

   Letter writing: Formal Letters – Letters accepting Offers - Chart description – process description – Essays – – Internship Reports

UNIT IV   **9**

   Self-Introduction - Talking about friends and Family –Resume Preparation: Single Page and Detailed– Persuasion Skills – Emotional Intelligence – Teamwork - Establishing Credibility: Understanding the Workplace – Body Language

UNIT V   **9**

Industry Psychology: Characteristics of the workplace: Physical working conditions: Noise, Illumination, Colour, Music, Miscellaneous Factors; Work Schedules: Working Hours, Permanent Part-Time Employment, Flexible Work Schedules; Psychological and Social Issues - Stress management – Time management

Total: 45 HOURS

COURSE OUTCOME

At the end of the course, students should be able to

CO1	Be prepared for the personal interview through mock interviews while being aware of the various kinds of interviews.
CO2	Introspect & develop a planned approach towards his career & life in general.
CO3	Have clarity on his career exploration process and match his skills and interests with a chosen career path.
CO4	Explain the use of a functional and chronological resume.
CO5	Develop thinking ability and polish his expression in group discussions.

COs	PROGRAMME OUTCOMES (POs)												CO/PSO Mapping PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1							2	2	2	3		2			2
CO2								1	2	3		2			2
CO3						2		2	3	3		2			2
CO4							3	2	1	3		3			3
CO5						3	3	3	3	3		3			3

Header: **CO/PO MAPPING (3- HIGH; 2- MEDIUM; 1 –LOW)** | **CO/PSO Mapping**

TEXT BOOKS

T1   Richards, C. Jack. Interchange Students Book-3 New Delhi: CUP, 2015.

T2   Skills for Employability, Dr. M. Sen Gupta, ISBN: 978-81-933819-1-5, 2020, First Edition

T3   Soft Skills & Employability Skills, SABINA PILLAI, AGNA FERNANDEZ, Cambridge, ISBN: 9781316981320, 1316981320, 2017

REFERENCE BOOKS

R1   Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young, ASIN ： 8126563435, ISBN-10 ： 9788126563432, ISBN-13 ： 978-8126563432, Pan Macmillan India; 2016

R2   Soft Skills Training: A workbook to develop skills for employment, Amazon Digital Services; Large edition, 2012, ISBN-10: 1468096494, ISBN-13 ： 978-1468096491

R3   https://www.sirc-icai.org/images/cabf/Soft%20Skills%20&%20Personality%20Development.pdf

R4   http://worldwideuniversity.org/library/bookboon/soft-skills.pdf

R5   https://www.futurelearn.com/subjects/business-and-management-courses/soft-skills

WEB RESOURCES

W1   https://bharatskills.gov.in/pdf/E_Books/EmployabilitySkillsSWB2W.pdf

W2   https://link.springer.com/book/10.1007/978-3-319-75166-5

W3   https://cbseacademic.nic.in/web_material/Curriculum21/publication/secondary/Employability_Skills10.pdf

W4   https://www.oreilly.com/library/view/soft-skills-for/9781119875536/

APPROVED BY BOS CHAIRMAN

OPEN ELECTIVE – I

U19EDOE001 INTELLECTUAL PROPERTY RIGHTS **L T P C**
3 0 0 3

Course Objectives:
This course aims to provide the students,
- Comprehensive knowledge on basic principles of IPR
- To know the rights and policies related to design, Patents, Copyright and Trademarks
- To understand the statutory provisions of IPRs
- To induce knowledge on Infringements
- To provide knowledge on how to keep the IP rights alive.

UNIT I INTRODUCTION 9
Basic Concepts - Need for IP - Types of IP - Design, Patent, Copyrights, Trademarks, Geographical Indications - Nature of IP – WTO – WIPO – TRIPS - Inventions and Innovations - Real time examples of IPR

UNIT II FORMS AND REGISTARTIONS 9
Types of forms - Practical aspects - registration and validity of Design, Patents, Copyrights, Trademarks, Trade secrets and Geographical Indications - Difference between Indian and International Patents - Case studies on Industrial Patents

UNIT III AGREEMENTS AND LEGISLATIVE ACTS 9
Patent Act of India - PCT agreement - Design Act - TRIPS Agreement - Patent Amendment Act - Trademark Act - Geographical Indication Act - Conventions and Infringements of IPR

UNIT IV IP LAWS AND DIGITAL INNOVATIONS 9
IP Laws - Cyber Laws - Protection of Innovations - Development of Assets - Unfair Competition - Cyber Laws Realtime case Studies

UNIT V EMERGING TRENDS IN INNOVATIONS AND IPRs 9
Emerging trends - Innovations in various domains - Industry 4.0 - Innocent Infringement - Case Studies ofinnovative products and services solving various social concerns

Total: 45 Hours

Course Outcomes:
At the end of the course, students should be able to,
CO1 : Differentiate and explain various forms of IPRs.
CO2 : Identify criteria's to fit one's own intellectual work in particular form of IPRs.
CO3 : Apply statutory provisions to protect particular form of IPRs.
CO4 : Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc.
CO5 : Identify procedure to protect different forms of IPRs national and international level.
CO6 : Develop skill of making search using modern tools and technics.

APPROVED BY BOS CHAIRMAN

	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping		
COs	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	-	1	-	-	-	1	1	1	2
CO2	2	1	-	-	-	2	1	-	2	-	2	1	1	1	-
CO3	-	-	-	-	-	3	-	3	-	1	-	2	2	1	-
CO4	-	2	-	-	-	1	-	3	2	-	-	1	2	1	2
CO5	-	2	1	1	-	2	1	3	1	1	-	2	2	1	-
CO6	2	1	1	-	3	2	1	3	1	-	-	2	2	1	2

Textbooks:

T1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2015.

T2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Publications, New Delhi, 2002.

T3. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

Reference Books:

R1. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw HillEducation, 2011.

R2. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, EdwardElgar Publishing Ltd., 2013.

OPEN ELECTIVE - II

U19EDOE002   **INNOVATION AND ENTREPRENEURSHIP**   **L T P C**
3 0 0 3

Course Objectives:

This course aims to provide the students,
- Understanding the scope of Entrepreneur.
- Knowledge about key area of innovation and Development.
- Knowledge about the financial assistance provided by central government and State government. • Ability to create their own business model.

UNIT I   INTRODUCTION TO ENTREPRENEURSHIP   9

Entrepreneurship and Entrepreneurs - Entrepreneurial Personality and Intentions - Characteristics, Traits and Behavioural Entrepreneurial Challenges.

**UNIT II   ENTREPRENEURIAL OPPORTUNITIES   9 **

Opportunities-Idea Generation - Discovery/ Creation - Pattern Identification and Recognition for Venture Creation: Prototype and Exemplar Model - Reverse Engineering

UNIT III   ENTREPRENEURIAL PROCESS AND DECISION MAKING   9

Entrepreneurial Ecosystem, Ideation - Development and Exploitation of Opportunities – Negotiation - Decision making Process and Approaches - Effectuation and Causation.

UNIT IV   CRAFTING BUSINESS MODELS AND LEAN START-UPS   9

Introduction to Business Models - Creating Value Propositions - Conventional Industry Logic - Value InnovationLogic - Customer Focused Innovation - Building and Analyzing Business Models - Business Model Canvas - Introduction to Lean Startups - Business Pitching

UNIT V   ORGANIZING BUSINESS AND ENTREPRENEURIAL FINANCE   9

Forms Of Business Organizations - Organizational Structures - Evolution of Organization - Sources and Selection of Venture Finance Options and its Managerial Implications - Policy Initiatives and Focus - Funding Support - Roles and Responsibilities in Promoting Entrepreneurship

Total: 45 Hours

Course Outcomes:

At the end of the course, students should be able to,
  CO1: Generate innovative ideas based on real time scenario.
  CO2: Scale up a enterprise.
  CO3: Understand the registration process and funding supports.
  CO4: Create value proposition and business pitching.
10 **Approved by BoS Chairman**
  CO5: Enable proper decision making and market fit.
  CO6: Advance skills in customer development, validation, competitive analysis in real world problems
          and projects.

	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping		
COs	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	3	3	2	-	-	1	-	-	3	2	-	1
CO2	-	-	3	2	-	2	1	3	-	-	-	3	2	1	3
CO3	-	-	-	-	1	2	2	-	1	-	-	2	2	1	3
CO4	-	1	2	1	1	-	-	-	-	-	-	1	2	-	-
CO5	2	-	1	2	-	3	2	-	-	-	-	1	-	1	-
CO6	3	-	-	-	2	-	-	-	-	-	-	1	2	-	3

Textbooks:

T1. S.S. Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
T2. Kuratko & Hodgetts, "Entrepreneurship – Theory, process and practices", Thomson learning 6th edition.

Reference Books:

R1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002. **R2.**Mathew J Manimala," Entrepreneurship theory at crossroads: paradigms and praxis" Dream tech 2nd edition 2006.
R3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
R4.EDII "Faulty and External Experts – A HandBook for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.

FOOD TECHNOLOGY

OPEN ELECTIVE - I

U19FTO E001

FOOD SCIENCE AND NUTRITION

L	T	P	C
3	0	0	3

Course Objectives:

Explain the basic concepts of food and nutrition. Define the overall classification, function, and source of carbohydrates, lipids and proteins. Discuss the overall aspects of vitamins. Outline the role of health and nutritional importance of micro and macro minerals. Summarize the recent trends in nutrition

PREREQUISITES

- Basic idea on biomolecules
- Knowledge of essential nutrition requirement
- Health benefits and function of nutrition
- Diet based nutrition
- Effect of storage and processing on nutrition

UNIT I HUMAN NUTRITION   9

Historical perspective of nutrient requirements – Assessment of nutritional status – recommended dietary allowances of macronutrients for all age groups – Assessment of protein quality – Malnutrition and related disorders – Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

UNIT II BIOMOLECULES   9

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Refined & Hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

UNIT III   VITAMINS   9

 Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins: Vitamin A, Vitamin D, E & K. Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6.

UNIT IV MINERALS   9

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride.

UNIT V RECENT TRENDS IN DIETETICS   9

Principles of dietary management in gout, rheumatism, AIDS/HIV – Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods, health foods and novel foods, organically grown foods, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

Total: 45HOURS

Course Outcomes:

At the end of the course students should be able to

CO1:	Discuss the basics in the area of nutritional assessment in health and disease and to categorize the recommended dietary allowances for different age groups
CO2:	Express the classifications, functions and sources of carbohydrates, lipids and proteins
CO3:	List the various attributes of fat- and water-soluble vitamins
CO4:	Report the role, bioavailability, sources and deficiency diseases of macro and micro minerals
CO5:	Recognize the diets and concepts of foods suggested for nutritional, chronic and acute disorders
CO6:	Classify and to analyse the different techniques of qualitative and quantitative analysis

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1														1	
2	3	2		3										1	
3	1	3			3			2							1
4	1				3			2							1
5															
6	1	1		2											

3 – High, 2 – Medium, 1 – Low

TEXT BOOKS:

T1: Gordon M. Wardlaw. Perspectives in Nutrition. WCB McGraw-Hill Publishers, Boston, 9th Edition. 2013.

T2: Shubhangini A. Joshi. Nutrition and Dietetics. Tata Mc Grow- Hill publishing Company Ltd, New Delhi. 4th Edition. 2016.

T3: Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017.

REFERENCE BOOKS:

R1: Ronald Ross Watson. Functional foods and Nutraceuticals in Cancer Prevention. Ed. Wiley – Blackwell. 2003.

R2: Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018.

APPROVED BY BOS CHAIRMAN

U19FTOE002	**Food Preservation Techniques**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

To introduce the students to the area of Food Processing and preservation.

To have an effective understanding of food processing and technology subjects.

To enable students to appreciate the importance of food processing with respect to the large-scale production.

To import knowledge on processing of food waste

Course Outcomes:

At the end of the course, learners will be able to:

C01: Describe the fundamentals of food processing and preservation

C02: Familiar with the functional properties of Carbohydrates, fats, lipids, proteins in food

C03: Knowledge about the importance of food additives and their function and will develop strategies that will promote food safety and prevent food borne illness

C04: Analyze the uses of enzymes, modified proteins and develop novel products, explain, analyze and evaluate scenarios related to various unit operations in food processing and preservation

C05: Identify spoilage and deterioration mechanism in food and methods to control deterioration and spoilage

C06: Demonstrate packing methods, materials and factors affecting food packing

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3												3
2	3														3
3	2		3										3		2
4	3	3	2								3			2	
5		3	2								3			2	
6	3	2	2	2	2	1	2								

3 - High, 2 - Medium, 1 – Low

UNIT I   PROCESSING OF FOOD AND ITS IMPORTANCE   9

Source of food - significance for processing and preservation of foods – Different food groups-, food pyramids, classification and functions, cooking of foods – methods and cooking media, advantages of processing of foods, changes of nutritional components in cooking, effects of processing of foods on anti-nutritional components.

UNIT II   FOOD COMPONENTS   9

Classification, Structure, nutritive value, processing outlines of major Cereals and millets-Pulses-fruits and vegetables, fats, oilseeds and nuts. Major and minor nutrients, sugar and related products, spices and aromatics, beverages and appetizers, organic foods

UNIT III   PROCESSING OF ANIMAL FOODS   9

Meat, Poultry and Fish-Structure, composition, nutritive value and processing outline. Processing of milk and milk products, egg processing and storage, need and nutritional benefits of animal products, value added products

UNIT IV   INTRODUCTION TO FOOD PROCESSING AND PRESERVATION   9

Food spoilage, fermentation, methods of preservation - High temperature and Low temperature Preservation, traditional methods of food processing and preservation, radiation processing, microwave, non-thermal techniques. Role of enzymes and additives in food preservation

UNIT V   FOOD PACKAGING AND QUALITY   9

Food packaging – importance, types and functions, packaging materials – synthetic and natural, Impact of packaging materials on food quality, shelf-life of foods, bottling and canning, nutritional labelling, labelling of vegan and animal based products

TOTAL: 45 HOURS

APPROVED BY BOS CHAIRMAN

TEXT BOOKS:

Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.

Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.

REFERENCES

Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005

WEBSITES:

1. https://www.heartfoundation.org.nz/educators/edu-resources/food-tech

2. https://www.stemcrew.org/guides/subjects/food-technology-teaching-resources/

OPEN ELECTIVE - II

			L	T	P	C
U19FTOE003	**BEVERAGE TECHNOLOGY**		**3**	**0**	**0**	**3**

Course Objectives:

Impart knowledge on processing and ingredients applied for beverage preparation according to the standard categorization of beverages. Based on the ingredients incorporated and type of processing method applied will give a classification of beverages. Sanitization schemes and quality control measures according to standards and regulations.

PREREQUISITES

- Basic classification of beverages in the market
- Storage and preparation of beverages
- Purpose of preparing beverages
- Market and trends in beverages sector

UNIT I   INGREDIENTS IN BEVERAGES   9

Beverage-definition--ingredients- water, quality evaluation and raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nano-emulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT II   CARBONATED BEVERAGES   9

Procedures- ingredients- preparation of Syrup making, carbonation of soft drinks. Carbonation equipments and machineries- -containers and closures. low-calorie and dry beverages; isotonic and sports drinks; Fruit based carbonated beverages, carbonated water

UNIT III   NON-CARBONATED BEVERAGES   9

Beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy based beverages, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages. bottled. Water; mineral water, natural spring water, flavored water.

UNIT IV   ALCOHOLIC BEVERAGES   9

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipment's used for brewing and distillation, wine and related beverages, distilled spirits

UNIT V   SANITATION AND QUALITY CONTROL   9

Quality control, Filling-inspection and quality controls-sanitation and hygiene in beverage industry-Quality of water used in beverages threshold limits of ingredients. FSSAI, EFSA and FDA regulations

Total: 45HOURS

COURSE OUTCOMES

At the end of the course students should be able to

CO1:   Understand the formulating beverages using various ingredients.

CO2:   Demonstrate various unit operations involved in the food beverage manufacturing

CO3:   Understand the various production techniques in beverages

CO4:   Evaluate the quality parameters of all beverages

CO5:   Familiarize with food laws and regulations of beverages

CO6:   Understand the natural and artificial colourants used in beverages

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2													
2	1	3												1	
3	1			3										1	
4					3			2							1
5					3			2							1
6	1	1		2											

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS:

T1: L.Jagan Mohan Rao and K.Ramalakshmi (2011)"Recent trend in Soft beverages", Woodhead Publishing India Pvt Ltd.

T2: Boulton, Christopher, and David Quain (2008) Brewing yeast and fermentation. John Wiley & Sons.

REFERENCE BOOKS:

R1: Hui, Yiu H., et al., eds. (2004) Handbook of food and beverage fermentation technology. Vol. 134. CRC Press.

R2: Mitchell, Alan J. (199) "Formulation and Production Carbonated Soft Drinks". Springer Science & Business Media.

R3: Woodroof, Jasper Guy, and G. Frank Phillips. (1981) Beverages: carbonated and noncarbonated. AVI Pub. Co

	L	**T**	**P**	**C**
U19FTOE004 **PRINCIPLES OF FOOD MATERIALS**	**3**	**0**	**0**	**3**

Course Objectives:

Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oil seeds. Summarize the production and processing methods of fruits and vegetables and to discuss the chemical composition, processing, production, spoilage and quality of milk and milk product. Outline the overall processes involved in the production of meat, poultry and fish products Review the production and processing methods of plantation and spice products

PREREQUISITES

- Need an idea of nature of food materials to be handled
- Prior storage conditions before processing the materials
- Basic handling techniques of materials
- Preparation of materials prior to processing

UNIT I   CEREAL, PULSES AND OIL SEEDS TECHNOLOGY   9

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

UNIT II   FRUITS AND VEGETABLE PROCESSING   9

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

UNIT III   DAIRY PROCESSING   9

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipment - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products – Ice cream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk.

UNIT IV   MEAT, POULTRY AND FISH PROCESSING   9

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing.

UNIT V   PLANTATION PRODUCT TECHNOLOGY   9

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

Total: 45HOURS

Course Outcomes:

At the end of the course students should be able to

CO1:   Discuss the various processing technologies involved in cereal, pulses and oilseed technology
CO2:   Demonstrate the major operations applied in fruits and vegetable processing
CO3:   Illustrate the techniques involved in the processing of dairy products
CO4:   List the overall processing of meat, poultry and fish processing
CO5:   Outline the processing of spices and plantation products
CO6:   Analyse the manufacturing methods involved in various byproducts of food materials

Course Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2													
2	1	3		3											
3	1													1	
4						3			2					1	
5						3			2						1
6	1	1		2											1

3 - High, 2 - Medium, 1 – Low

TEXT BOOKS:

T1: Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition. 2010.

T2: Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition. 2003.

REFERENCE BOOKS:

R1: Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression. 2016.

.

OPEN ELECTIVE – I

U19ITOE001	UI AND UX DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES
- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype.

COURSE OUTCOMES:
At the end of the course students should be able to
CO1: Understand the principles of UI and UX design, including user-centered design, information architecture, visual hierarchy, and usability testing.
CO2: Build UI for user Applications
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles
CO6: Create Wireframe and Prototype

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW													CO/PSO Mapping		
CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3		2				3		2	2	3	3	2
CO2	3	2	3		2				3		2	2	3	3	2
CO3	3	2	3		2				3		2	2	3	3	2
CO4	3	2	3		2				3		2	2	3	3	2
CO5	3	2	3		2				3		2	2	3	3	2
CO6	3	2	3		2				3		2	2	3	3	2

UNIT I: FOUNDATIONS OF DESIGN   9
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

UNIT II: FOUNDATIONS OF UI DESIGN   9
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides 126

UNIT III: FOUNDATIONS OF UX DESIGN   9
 Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT IV: WIREFRAMING, PROTOTYPING AND TESTING   9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V: RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE   9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

Total: 45 HOURS

TEXT BOOKS

1.Joel Marsh, "UX for Beginners", O'Reilly , 2022

2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021 127

3. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Systems", Springer IE, 2004.

REFERENCE BOOKS

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020

2. Steve Schoger, Adam Wathan "Refactoring UI", 2018

3. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015

4. https://www.nngroup.com/articles/

5. https://www.interaction-design.org/literature.

U19ITOE002 **MULTIMEDIA SYSTEMS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES
- To enrich student learning in multimedia systems.
- To train the students to acquire knowledge in multimedia related technologies.
- To acquire knowledge about multimedia techniques to enhance quality of service.
- To acquire knowledge on multimedia architecture.
- To learn about the multimedia elements in a comprehensive way.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Handle the multimedia elements effectively

CO2: Encode and decode the multimedia elements.

CO3: Understand the underlying multimedia computing architectures used for media development.

CO4: Develop effective strategies to deliver Quality-of-Experience in multimedia applications.

CO5: Design and implement algorithms and techniques related to multimedia objects**.**

CO6: Design and develop multimedia applications in various domains

CO s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3		3	2	2			3	2		2		3
CO2	3	2	3		3	2	2			3	2		2		3
CO3	3	2	3		3	2	2			3	2		2		3
CO4	3	2	3		3	2	2			3	2		2		3
CO5	3	2	3		3	2	2			3	2		2		3
CO6	3	2	3		3	2	2			3	2		2		3

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW — PROGRAMME OUTCOMES (POs); CO/PSO Mapping — PSOs

UNIT I: **INTRODUCTION TO MULTIMEDIA ELEMENTS** 9

Multimedia – Medium – Properties of a Multimedia System – Traditional Data Stream Characteristics – Data Stream Characteristics of Continuous Media – Basic Sound Concepts – Speech – Images and Graphics – Computer Image Processing – Video and Animation – Computer Based Animation.

UNIT II: **MULTIMEDIA COMPRESSION** **9**

Storage Space – Coding Requirements – Hybrid Coding – JPEG: Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode – H.261 – MPEG: Video Encoding, Audio Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21 – DVI – Audio Encoding

UNIT III: **MULTIMEDIA ARCHITECTURES** **9**

User Interfaces – OS multimedia support – Multimedia Extensions – Hardware Support – Distributed multimedia applications – Real time protocols – Play back Architectures – Synchronization – Document and document architecture – Hypermedia concepts – Hypermedia design – Digital copyrights – Digital Library – Multimedia Archives.

UNIT IV: MULTIMEDIA OPERATING SYSTEM AND DATABASES   9

Real Time – Resource Management – Process Management – File systems – Interprocess communication and synchronization – Memory management – Device Management – Characteristics of MDBMS – Data Analysis – Data structures – Operations on data – Integration in a database model.

UNIT V: MULTIMEDIA COMMUNICATION &APPLICATIONS   9

Tele Services – Implementation of Conversational Services, Messaging Services, Retrieval Services, Tele Action Services, Tele Operation Services – Media Consumption – Media Entertainment – Virtual Reality – Interactive Audio – Interactive Video – Games.

Total: 45 HOURS

TEXT BOOKS

1. Ralf Steinmetz, Klara Nahrstedt, "Multimedia computing, communications, and applications", Pearson India, 2009.

2. Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw Hill Education, 2017.

3. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Systems", Springer IE, 2004.

REFERENCE BOOKS

1. Tay Vaughan, "Multimedia: Making it Work", McGraw – Hill Education, Ninth Edition, 2014.

2. Mark S Drew, Zee Nian Li, "Fundamentals of multimedia", Prentice Hall, 2006.

3. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. "Baker Digital Compression for Multimedia: Principles and Standards", Elsevier, 2006.

U19ITOE003	**FOUNDATION OF INFORMATION TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- Understand the basic concepts and terminology of information technology
- Identify the components of a computer system and their functions
- Describe different types of software and their applications
- Explain the principles of computer networking and internet technologies
- Understand the basics of database design and management
- Use IT effectively in personal and professional settings

Course Outcomes:

At the end of the course students should be able to

CO1: Understand fundamental concepts, principles, and applications of information technology

CO2: Understand the different types of software and their applications

CO3: Understand the basics of database design and management.

CO4: Understand the role of information systems in organizations and their applications

CO5: Understand the principles of computer networking and internet technologies

CO6: Apply IT effectively in personal and professional settings.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW													CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
CO s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3			2		2		3	2	3	3		3
CO2	3		3			2		2		3	2	3	3		3
CO3	3		3			2		2		3	2	3	3		3
CO4	3		3			2		2		3	2	3	3		3
CO5	3		3			2		2		3	2	3	3		3
CO6	3		3			2		2		3	2	3	3		3

UNIT I: **Basics of Information Technology** 9

Internet: World Wide Web, Web servers, Web Clients, Web sites, Web Pages, Web Browsers, Blogs, News groups, HTML, Web address, E-mail address, URL, HTTP, FTP, downloading and uploading files from remote site; Services available on Internet: Information Retrieval, Locating sites using search engines and finding people on the net; Web Services: Chat, email, Video Conferencing, e-Learning, e-Banking, e-Shopping, e-Reservation, e-Governance, e-Groups, Social Networking

UNIT II: **Information Processing Tools**   **9**

Office Tools: Database Management Tool: Basic Concepts and need for a database, Creating a database. DataTypes-Text, Number, Date, Time, Setting the Primary Key, Entering data into a database, Inserting and deleting Fields, Inserting and deleting Records, Field Size, Default Value, Creating Query using Design view.

UNIT III: **Hyper Text Markup Language**   **9**

Introduction to Web Page Designing using HTML, Creating and saving an HTML document, accessing a web page using a web browser (Google Chrome, Internet Explorer, Mozilla Firefox, Opera, Apple Safari, Net scape Navigator);

Elements in HTML.

UNIT IV: **XML**   **9**

Introduction to XML, Difference between XML and HTML with respect to the following: Data separation, data sharing, document structure, tags, nesting of elements, attributes, values. XML Elements - Defining own tags in XML, root elements, child elements and their attributes; Comments in XML, White space and new line in XML, well formed XML documents, validating XML documents, XML Parser, Viewing XML documents in a web browser.

UNIT V: **Societal Impacts of IT**   9

Information Security: Virus, Worms, Trojans and Anti-Virus Software, Spyware, Malware, Spams, Data Backup and recovery tools and methods, Online Backups, Hacker and Cracker with regard to Computer Data and Applications, Social Networking Information security provisions in e-commerce, Benefits of ICT in Education, Healthcare, Governance, Virtual, School, emergence of Knowledge economy, Impact of ICT on Society: Knowledge based society, Infomania, Digital Unity and Digital Divide

                                                                 Total: 45 HOURS

TEXT BOOKS

1. Introduction to Information Technology" by Turban, Rainer, and Potter (Wiley, 2015)

2. Discovering Computers" by Vermaat, Sebok, and Freund (Cengage Learning, 2019)

REFERENCE BOOKS

1. Computer Science Illuminated" by Nell Dale and John Lewis (Jones & Bartlett Learning, 2018)

2. Computer Science Illuminated" by Nell Dale and John Lewis (Jones & Bartlett Learning, 2018)

U19ITOE004	WEB DESIGN AND MANAGEMENT		L	T	P	C
			3	0	0	3

COURSE OBJECTIVES
- To Learn the basic concepts in HTML, CSS, Javascript.
- To Understand the responsive design and development.
- To Understand the responsive design and development.
- To Design a Website with HTML, JS, CSS / CMS - Word press.

COURSE OUTCOMES:

At the end of the course students should be able to

CO1: Understand the principles of web design, including layout, color theory, typography, and user experience design.

CO2: Design Website using HTML CSS and JS

CO3: Design Responsive Sites

CO4: Manage, Maintain and Support Web Apps

CO5: Gain practical experience working on real-world web design projects, and learn how to collaborate with clients, stakeholders, and team members.

CO6: Develop an understanding of web analytics and digital marketing, and learn how to use data to improve website performance and user engagement.

	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW												CO/PSO Mapping		
CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		3		3	3	2		3		3	3	3		3
CO2	3		3		3	3	2		3		3	3	3		3
CO3	3		3		3	3	2		3		3	3	3		3
CO4	3		3		3	3	2		3		3	3	3		3
CO5	3		3		3	3	2		3		3	3	3		3
CO6	3		3		3	3	2		3		3	3	3		3

UNIT I: WEB DESIGN - HTML MARKUP FOR STRUCTURE 9

Working of Web - HTML Markup for Structure - Creating simple page - Marking up text - Adding Links - Adding Images - Table Markup - Forms - HTML5

UNIT II: CSS AND JAVASCRIPT 9

CSS - Formatting text - Colours and Background - Padding, Borders and Margins - Floating and positioning - Page Layout with CSS - Transition, Transforms and Animation - Javascript - Using Java Script

UNIT III: RESPONSIVE WEB DESIGN 9

Sass for Responsive Web Design - Marking Content with HTML5 - Mobile-First or Desktop-First - CSS Grids, CSS Frameworks, UI Kits, and Flexbox for RWD - Designing small UIs by Large Finger - Images and Videos in Responsive Web Design - Meaningful Typography for Responsive Web Design

UNIT IV: **WEB PROJECT MANAGEMENT**   9

Project Life Cycle - Project Definition - Discovery and Requirements - Project Schedule and Budgeting - Running the project - Technical Documentation - Development ,Communicaton, Documentation - QA and testing -Deployment - Support and operations

UNIT V: **PROJECT CASE STUDY**   9

Using HTML, CSS, JS or using Opensource CMS like Wordpress, design and develop a Website having Aesthetics, Advanced and Minimal UI Transitions based on the project - Host and manage the project live in any public hosting.

| **Total: 45 HOURS**

TEXT BOOKS

1. Jennifer Niederst Robbins, "Learning Web Design", O'REILLY 4th Edition
2. Ricardo Zea, "Mastering Responsive Web Design", PACKT Publishing, 2015
3. Justin Emond, Chris Steins, "Pro Web Project Management", Apress,2011

REFERENCE BOOKS

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley and Sons, edition 2014
2. Jon Duckett, Jack Moore, "JavaScript &JQuery: Interactive Front-End Web Development", John Wiley and Sons, edition 2014
3. Uttam K. Roy "Web Technologies" Oxford University Press, 13th impression, 2017
4. Wordpress - http://www.wpbeginner.com/category/wp-tutorials/

OPEN ELECTIVE – I

| 19MEOE001 | ENGINEERING DRAWING | L
2 | T
0 | P
2 | C
3 |

COURSE OBJECTIVES
- To have the knowledge of interpretation of dimensions of different quadrant projections.
- To understand the basic principles of engineering drawing.
- To have the knowledge of generating the pictorial views

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		3									3	2	
CO2	3	2		3				2					3	2	
CO3	3	3		3									3	2	
CO4	3	2		3				2					2	2	
CO5	3	2		3									3	2	

PRE-REQUISITES

Nil

THEORY COMPONENT CONTENTS

UNIT I   INTRODUCTION TO ENGINEERING DRAWING   9

Principles of engineering graphics and their significance – drawing instruments and their use – conventions in drawing – lettering – BIS conventions. Dimensioning rules, geometrical construction Curves Used In Engineering Practice And Their Constructions: Conic Sections, Special Curves-Cycloids, Epicycloids, and Hypocycloids.

UNIT II   ORTHOGRAPHIC PROJECTION IN FIRST ANGLE PROJECTION ONLY   9

Principles of orthographic projections – conventions – first and third angle projections. Projections of points and lines inclined to both the planes.

UNIT III   PROJECTIONS OF PLANES AND SOLIDS   9

Projections of regular planes, inclined to both planes. Projections of regular solids inclined to both planes.

UNIT IV   DEVELOPMENT OF SURFACES   9

Development of surfaces of right, regular solids – development of prisms, cylinders, pyramids, cones and their parts.

UNIT V   ISOMETRIC PROJECTIONS   9

Principles of Isometric Projections-Isometric Scale- Isometric Views-Conventions-Plane Figures, Simple and Compound Solids. Transformation Of Projections: Conversion of isometric Views to Orthographic Views. Conversion of orthographic views to isometric projections vice-versa

Total:45 Hours

Course Outcomes:

On completion of this course students will be able to

CO1 : Prepare and understand drawings.

CO2 : Identify various D curves used in Engineering Drawing and their applications.

CO3 : Use the principles of orthographic projections.

CO4 : By studying about projections of solids students will be able to visualize three dimensional objects and that will enable them to design new products.

CO5 : Design and fabricate surfaces of different shapes.

TEXT BOOKS

T1.   Basant Agarwal, "Engineering Drawing", TMH.

T2.   Jolhe, Dhananjay "Engineering Drawing: With an Introduction to CAD", Tata McGraw Hill, India. 2006.

REFERENCE BOOKS

R 1.   N. D. Bhat, "Engineering Drawing" Charotar Publications, NewDelhi., 2006.

R2.   Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International Publishers, 2007

U19MEOE002   **MODERN MANUFACTURING TECHNIQUES**

COURSE OBJECTIVES

• To understand the various advancements in casting processes
• To learn about the different types of welding techniques.
• To understand the principles and process of forming.
• To understand the significance of different advancements such as CAE in manufacturing.
• To learn about the mechanics of high speed machining.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO3	PS3
CO1	1	2		2		2		2		2			2		
CO2				1									1		
CO3		1		2									2		
CO4	1	1		1		1				1			1		
CO5	2			1		1		2					1		

PRE-REQUISITES

1. Fundamentals of manufacturing processes.

THEORY COMPONENT CONTENTS

UNIT I   **ADVANCED CASTING PROCESSESES**   **9**

Expendable-Mold - shell mould casting, Vacuum Mould casing, investment casting, plaster-mold and ceramic-mold casting, Permanent-Mold casting processes - squeeze casting and semisolid metal casting, centrifugal casting, uses of Rapid Prototyping to produce pattern, process selection - dimensional tolerances for various casting processes and metals.

UNIT II   **ADVANCED WELDING PROCESSES**   **9**

Electron beam welding, laser beam welding, Solid-State welding - diffusion welding, friction welding, ultrasonic welding, physics of welding, design considerations in welding, NDT methods for testing.

UNIT III   **ADVANCED FORMING PROCESSES**   **9**

Material behavior in metal forming, temperature in metal forming, strain rate sensitivity, friction and lubrication in metal forming, bulk deformation processes, sheet metalworking, HERF, hydro forming, explosive forming, magnetic forming process

UNIT IV   **APPLICATION OF CAE IN MANUFACTURING**   9

Need for CAE in manufacturing, simulation of molten metal flow using CAE Techniques, solidification process in casting, inspections of casting. Thermal analysis of Heat-Affected Zone (HAZ), analysis of forging process using CAE, CL data generation for machining process.

High-Speed machining centers, high-speed spindles, spindle sped, feed rate, cutting velocity, surface finish, selection of process parameters, ultra-high-speed machining centers, hard machining.

Total: 45 Hours

COURSE OUTCOMES

At the end of the course students should have the

CO1 :   Use appropriate casting technique to develop a given component

CO2 :   Make the right choice of welding technique as per the required application

CO3 :   Understand about the different significant factors in forming

CO4 :   Formulate real time problems with the help of computer simulation tools

CO5 :   Implementing the probable capabilities of artificial intelligence to develop end user products such as robots.

TEXT BOOKS

T1.   Mikell P Grover "Principles of Modern Manufacturing (SI Version)" John Wiley & Sons, 2014.

T2.   Paul DeGarmo E, Black J T and Ronald A Kohjer, "Materials and Processes in Manufacturing, John Wiley India, 2011.

REFERENCE BOOKS

R 1.   Philip F Ostwald and Jairo Munoz, "Manufacturing Processes and Systems" John Wiley India, New Delhi, 2013.

R2.   Kaushish J P, "Manufacturing Processes", Prentice Hall India, 2013.

R3.   Sanjay K Mazumdar, "Composite Manufacturing: Materials, Product and Process Engineering", CRC Press, 2010.

OPEN ELECTIVE – II

			L	T	P	C
U19MEOE003	**AUTOMOBILE TECHNOLOGY**		3	0	0	3

COURSE OBJECTIVES
- To gain knowledge on the automobile architecture and understand its performance.
- To learn about the significant parameters that determines the engine performance.
- To learn about the different types of transmission systems used in automobiles
- To understand the different components and mechanism of a suspension system
- To learn about the mechanism involved in operation of steering

PRE-REQUISITES
Nil

THEORY COMPONENT CONTENTS

UNIT I   AUTOMOBILE ARCHITECTURE AND PERFORMANCE   9

Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

UNIT II   ENGINE ARCHITECTURE AND PERFORMANCE   9

Types of engine, multi valve engine, in-line engine, vee-engine, Petrol enginedirect, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles, Engine Control Unit.

UNIT III   TRANSMISSION SYSTEMS   9

Clutch : Types-coil spring and diaphragm type clutch, single and multi-plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling

UNIT IV   SUSPENSION SYSTEM   9

Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems.

UNIT V   STEERING SYSTEM   9

Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.

Total: 45 Hours

COURSE OUTCOMES
At the end of the course students should have the ability to

CO1 :   Apply the concepts of automobile architecture in an automobile assembly.
CO2 :   Device the right choice of process parameters to fine tunes the performance.
CO3 :   Choose the right choice of transmission system as per the requirements
CO4 :   Make the right choice of suspension system for the given application
CO5 :   Visualize and understand the working mechanism of steering.

TEXT BOOKS
   T1.   Gupta .R.B, "Automobile Engineering ", SatyaPrakashan, 2009.
   T2.   Kirpal Singh, "Automobile Engineering Vol-I & II", Standard publishers, New Delhi, 2011.

REFERENCE BOOKS
   R 1.   Julian Happian Smith, "An Introduction to Modern Vehicle Design", Butterworth-Heinemann, New Delhi, 2002

Mapping of Course outcomes (COs) to Program outcomes (POs)
CO/PO MAPPING (S/M/W indicates strength of correlation

	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	1	1		3				3					3	2	
CO 2	2	1						2					3	2	
CO 3	3	2		1				1					3	2	
CO 4	1	3		3				2					2	2	
CO 5	3	2											3	2	

3-HIGH; 2 MEDIUM; 1 – LOW

Course Objectives:

To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

CO/PO MAPPING (S/M/W indicates strength of correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		3									3	2	
CO2	3	2		3				2					3	2	
CO3	3	3		3									3	2	
CO4	3	2		3				2					2	2	
CO5	3	2		3									3	2	

3-HIGH; 2-MEDIUM; 1 –LOW

PRE-REQUISITES

Engineering Drawing

THEORY COMPONENT CONTENTS

UNIT I   INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS   9

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation.

UNIT I   CURVES AND SURFACES MODELING   9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermitebicubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT III   NURBS AND SOLID MODELING   9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid Geometry - comparison of representations - user interface for solid modelling.

UNIT IV   VISUAL REALISM   9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

UNIT V   ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE   9

Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc– Communication standards.

                                                                                        Total:45 Hours

COURSE OUTCOMES

At the end of the course students should be able to

CO1 :   Understand the fundamentals of computer graphics.

CO2 :   Apply different techniques for geometric modelling.

CO3 :   Apply different algorithm to create prismatic and lofted parts.

CO4 :   Discuss tolerance analysis and mass property calculations.

CO5 :   Explain data exchange standards and communication standards.

TEXT BOOKS

T1.   David F. Rogers, James Alan Adams, "Mathematical elements for computer graphics", second edition, Tata McGraw-Hill edition.

T2.   Ibrahim Zeid,   "Mastering CAD/CAM", McGraw Hill, International Edition, 2007.

REFERENCE BOOKS

R 1.   Donald Hearn and M. Pauline Baker, "Computer Graphics" Prentice Hall, Inc., 1992.

R2.   William M Neumann and Robert F.Sproul, "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

PHYSICS

U19PHOE001	**NANOTECHNOLOGY AND ENGINEERING APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- To introduce the concept of nanotechnology and understand the importance of nanotechnology
- To give deep insight into fabrication and characterization techniques for nanostructures
- To provide an overview of the wide applications of nanotechnology in various technological fields.

PRE-REQUISITES: As a prerequisite for this course Nanotechnology and Engineering Applications, knowledge in Engineering Physics and Applied Physics is essentially required.

THEORY COMPONENT CONTENTS

UNIT I   INTRODUCTION AND SYNTHESIS OF NANOMATERIALS   9

Introduction to nanotechnology –definition, invention, building blocks of nanotechnology, chemical bonds - Van der Waals Interactions, Dipole-Dipole interactions, Microstructure and Defects in Nanocrystalline Materials – dislocations, twins, stacking points and voids; grain boundaries, triple junctions and disclinations.
Synthesis of nanomaterials**:** Bottom – Up Approaches: physical vapour deposition (PVD), chemical vapour deposition (CVD), spray pyrolysis. Top- Down Approaches: Mechanical alloying, high pressure torsion (HPT)

UNIT II   TYPES OF NANOMATERIALS   9

Carbon Nanotubes (CNT): Introduction, classification of CNT'S, synthesis and physical properties of CNT (Electrical, Transport, Mechanical), applications.
Fullerenes: Introduction, synthesis and purification, physical properties, applications. Semiconductor Quantum dots: Introduction, synthesis of Quantum dots, physical and chemical properties, applications.
Nanocomposites: Introduction, synthesis and processing of Inorganic nanotubes and polymeric nanocomposites, applications.
Nanowires: Introduction, physical properties of nanowires – (structural, Optical, Chemical), Applications.

UNIT III   PROPERTIES OF NANOMATERIALS   9

Mechanical Properties: Introduction, Grain Size Effect, Creep, Hardness, Fracture Strength, Strengthening and Toughening Mechanisms, Crack Healing (Annealing Treatment). [From Advanced nanomaterials by Hofman, Powder Technology Laboratory, IMX, EPFL, Version 1 Sept 2009].
Electrical and Optical properties: Electrical conduction and tunnelling conduction in nanoparticles, electronic conduction with nanoparticles (AC Conductivity & DC Conductivity).
Optical properties: Transmission, Absorption, Reflection in nanoparticles, optical constants (Absorption coefficient, extinction coefficient and Refractive index).

UNIT IV   CHARACTERIZATION TOOLS   9

XRD (X-Ray diffraction), SAXS (Small Angle X-ray Emission Spectroscopy), SEM (Scanning Electron Microscopy), TEM (Transmission Electron Microscopy), STM (Scanning Tunnelling Microscopy), AFM (Atomic Force Microscopy).

UNIT V   APPLICATIONS OF NANOTECHNOLOGY   9

Electrical and electronic applications: MEMS (Micro Electro Mechanical Systems), NEMS (Nano Electro Mechanical Systems), Nanosensors, nanolithography.
Nanotechnology for Renewable Energy: Hydrogen energy, fuel cell technology, wind and solar energy. Nanotechnology for information technology and Data Storage applications.

Total:45 Hours

COURSE OUTCOME

At the end of the course, students should be able to

CO1	Understand the basic concepts of nanotechnology
CO2	Gain basic knowledge on various synthesis and techniques involved in preparation of nanomaterials
CO3	Understand the general types and different classes of Nanomaterials
CO4	Apply the knowledge on different properties of Nanomaterials and selection of material for the specific purpose of application.
CO5	Understand and apply the knowledge of different characterization tools and characterization of Nanomaterials
CO6	Apply the basic knowledge about the wide applications of nanotechnology in various technological fields.

CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH, 2-MEDIUM, 1-LOW													CO/PSO Mapping		
CO s	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3													
CO2	3	3													
CO3	3	3													
CO4	3	3													
CO5	3	3													
CO6	3	3													

TEXT BOOKS

T1	Köhler, Michael, and Wolfgang Fritzsche. Nanotechnology - An Introduction to Nanostructuring Techniques 2nd ed. Wiley.
T2	T. Pradeep, Nano: The Essentials – Understanding Nano Science and Nano Technology, McGraw-Hill
T3	A. K. Bandyopadhyay, Nano Materials, New Age International Publishers.
T4	M. H. Fulekar, Nanotechnology - Importance and applications. I.K. International publishing house pvt. Ltd

REFERENCE BOOKS

R1	B.S. Murty, P. Shankar, Baldev Raj, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Berlin Heidelberg
R2	B. Bhushan, Springer Handbook of Nano Technology

U19PHOE002   THIN FILM TECHNOLOGY AND APPLICATIONS   L   T   P   C

COURSE OBJECTIVES
- To learn the fundamental atomistic mechanisms and thin film deposition techniques.
- To acquire knowledge on thin film devices.
- To provide an overview of the wide applications of thin film technology in various technological fields.

PRE-REQUISITES: As a prerequisite for this course Nanotechnology and Engineering Applications, knowledge in Engineering Physics and Applied Physics is essentially required.

THEORY COMPONENT CONTENTS

UNIT I   THIN FILM GROWTH   9

Classification of films – formation of films – Condensation and nucleation, growth and coalescence of islands – nucleation theories: capillarity and atomistic models, sticking coefficient, adhesion, substrate effect

UNIT II   DEPOSITION TECHNIQUES   9

Thin film deposition techniques – simple thermal evaporation – Chemical vapour deposition technique – advantages and disadvantages of Chemical vapour deposition, Physics vapour deposition, electron beam evaporation – RF sputtering, flash evaporation, laser ablation – Spin coating – molecular beam epitaxy – ellipsometry, quartz crystal oscillator techniques, structure, and microstructure of thin films.

UNIT III   THIN FILM MATERIAL CHARACTERIZATION TECHNIQUES   9

Characterization techniques: X-Ray diffraction, working principle of SEM, working principle of Transmission Electron Microscopy, Scanning Tunnelling Microscopy, AFM, Filed ion microscope.

UNIT IV   PROPERTIES OF THIN FILMS   9

Electrical conduction in continuous and discontinuous metallic thin films, transport and optical properties of metallic, semiconducting and dielectric films.

UNIT V   THIN FILM DEVICES AND APPLICATIONS   9

Anti – reflection Coatings, fabrication of thin film resistor, capacitor, diode, gas sensors and temperature sensors. Thin film solar cells, Quantum well and dot solar cells. Application of thin films, in different areas such as electronics, medical defence, sports, and automobile.

Total:45 Hours

COURSE OUTCOME

At the end of the course, students should be able to

CO1	Understand the basic concepts of thin film technology.
CO2	Understand the classification of thin films.
CO3	Understand the various thin film deposition techniques.
CO4	Understand and apply the knowledge of different characterization tools and characterization of thin films.
CO5	Describe the properties of thin films.
CO6	Apply the basic knowledge about the wide applications of thin film technology in various technological fields.

CO s	CO/PO MAPPING (S/M/W indicates strength of correlation) 3-HIGH 2-MEDIUM, 1-LOW												CO/PSO Mapping		
	PROGRAMME OUTCOMES (POs)												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3													
CO2	3	3													
CO3	3	3													
CO4	3	3													
CO5	3	3													
CO6	3	3													

TEXT BOOKS

T1   Kasturi Chopra, Thin film device applications, McGraw Hill, Newyork, 2012

T2   A. Goswami, Thin film fundamentals, New age international, 2006

REFERENCE BOOKS

R1   Manuel P. Soriaga, John Stickney, Lawrence A. Bottomley, Thin Films: Preparation, Characterization, Applications, Springer US

R2   Krishna Seshan, Handbook of Thin film Deposition Processes and Techniques, Elseiver.

APPROVED BY BOS CHAIRMAN