

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
B. TECH. FOOD TECHNOLOGY
CHOICE BASED CREDIT SYSTEM

1. Programme Educational Objectives (PEOs)

- I. To prepare students as a qualified food technologists for Food industries, research organization and teaching.
- II. To provide students with a solid foundation in basic sciences related to food technology, food science and food technology & engineering.
- III. To enable the students with good scientific and engineering knowledge so as to comprehend, design, and create food products and device for food industry and provide solutions for the challenges in food industry as well as in agriculture.
- IV. To train students in professional and ethical attitude, effective communication skills, teamwork skills and multidisciplinary approaches related to food technology and engineering.
- V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

2. Programme Outcomes (POs)

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, food science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve engineering problems related to food sector/industry.
3. Graduate will able to focus on the importance of safe processed nutritious food.
4. Graduates will demonstrate an ability to design or process food products as per the needs and specifications.
5. Graduates will demonstrate an ability to work in Food industries, research organization and teaching.
6. Graduate will demonstrate skills to use modern tools and equipment to analyze food prone infection and food spoilage.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to understand economic importance of food products and food laws.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.

Programme Educational Objectives	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
I		✓		✓	✓		✓			
II	✓	✓			✓				✓	
III	✓	✓		✓	✓					
IV						✓	✓	✓	✓	
V							✓	✓	✓	✓

3. Mapping for B. Tech. Food Technology – R2017

		1	2	3	4	5	6	7	8	9	10
1	SEM 1	Communicative English			✓				✓		
		Engineering Mathematics I	✓	✓							
		Engineering Physics	✓	✓							
		Engineering Chemistry	✓	✓							
		Problem Solving and Python Programming	✓		✓						
		Engineering Graphics	✓								
		Problem Solving and Python Programming Laboratory								✓	
		Physics and Chemistry Laboratory								✓	
	SEM 2	Technical English					✓				
		Engineering Mathematics II	✓	✓							
		Physics of Materials	✓	✓						✓	
		Basic Civil and Mechanical Engineering									
		Microbiology	✓							✓	
		Biochemistry	✓							✓	
Engineering Practices Laboratory											
Biochemistry Laboratory									✓		
Year 2	SEM 3	Transforms and Partial Differential Equations	✓								
		Introduction to Food Processing			✓	✓					
		Food Process Calculations		✓							✓
		Food Microbiology									
		Principles of Fluid Mechanics		✓	✓						
		Food Chemistry and Nutrition									
		Food Microbiology Lab					✓	✓			
		Food Chemistry and Nutrition Lab					✓	✓			
		Interpersonal Skills/Listening and Speaking					✓				
Year 2	SEM 4	Probability and Statistics	✓								
		Food Analysis			✓	✓					
		Fundamentals of Heat and Mass		✓							✓

		Transfer											
		Environmental Science and Engineering											✓
		Thermodynamics	✓	✓									
		Unit Operations for Food Industries	✓										
		Food Analysis Laboratory				✓	✓						
		Unit Operations Laboratory				✓	✓						
		Advanced Reading and Writing				✓							
Year 3	SEM 5	Food Additives		✓	✓								
		Biochemical Engineering for Food Technologists		✓									
		Refrigeration and Cold Chain Management		✓									
		Food Processing and Preservation			✓	✓							
		Professional Communication	✓									✓	
		Food Processing and Preservation Lab					✓	✓					
		Biochemical Engineering Lab	✓				✓	✓					
Year 3	SEM 6	Food Process Engineering and Economics		✓									
		Baking and Confectionary Technology			✓	✓							
		Fruits and Vegetable Processing Technology			✓	✓							
		Fruits and Vegetable Processing Technology Lab					✓	✓					
		Baking and Confectionary Technology Lab					✓	✓					
Year 4	SEM 7	Dairy Process Technology		✓	✓								
		Food Safety, Quality and Regulation				✓							
		Food Packaging Technology			✓								
		Testing of Packaging Materials Lab					✓	✓					
		Dairy Process Technology Lab					✓	✓					
Year 4	SEM 8	Project Work					✓				✓	✓	

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
B. TECH. FOOD TECHNOLOGY
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS (FULL TIME) CURRICULA AND SYLLABI

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS8151	Communicative English	HS	4	4	0	0	4
2	MA8151	Engineering Mathematics - I	BS	4	4	0	0	4
3	PH8151	Engineering Physics	BS	3	3	0	0	3
4	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
TOTAL				31	19	0	12	25

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS8251	Technical English	HS	4	4	0	0	4
2	MA8251	Engineering Mathematics – II	BS	4	4	0	0	4
3	PH8254	Physics of Materials	BS	3	3	0	0	3
4	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
5	BT8291	Microbiology	PC	3	3	0	0	3
6	FD8201	Biochemistry	PC	3	3	0	0	3
PRACTICALS								
7	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8	BT8261	Biochemistry Laboratory	PC	4	0	0	4	2
TOTAL				29	21	0	8	25

SEMESTER III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2	FD8301	Introduction to Food Processing	PC	3	3	0	0	3
3	FD8302	Food Process Calculations	PC	5	3	2	0	4
4	FD8303	Food Microbiology	PC	3	3	0	0	3
5	FD8304	Principles of Fluid Mechanics	PC	5	3	2	0	4
6	FD8305	Food Chemistry and Nutrition	PC	3	3	0	0	3
PRACTICALS								
7	FD8311	Food Microbiology Laboratory	PC	4	0	0	4	2
8	FD8312	Food Chemistry and Nutrition Laboratory	PC	4	0	0	4	2
9	HS8381	Interpersonal Skills/Listening and Speaking	EEC	2	0	0	2	1
TOTAL				33	19	4	10	26

SEMESTER IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA8391	Probability and Statistics	BS	4	4	0	0	4
2	FD8401	Food Analysis	PC	3	3	0	0	3
3	FD8491	Fundamentals of Heat and Mass Transfer	PC	5	3	2	0	4
4	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
5	FD8402	Thermodynamics	PC	3	3	0	0	3
6	FD8403	Unit Operations for Food Industries	PC	3	3	0	0	3
PRACTICALS								
7	FD8411	Food Analysis Laboratory	PC	4	0	0	4	2
8	FD8412	Unit Operations Laboratory	PC	4	0	0	4	2
9	HS8461	Advanced Reading and Writing	EEC	2	0	0	2	1
TOTAL				31	19	2	10	25

SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	FD8501	Food Additives	PC	3	3	0	0	3
2.	FD8502	Biochemical Engineering for Food Technologists	PC	4	4	0	0	4
3.	FD8503	Refrigeration and Cold Chain Management	PC	3	3	0	0	3
4.	FD8504	Food Processing and Preservation	PC	3	3	0	0	3
5.		Professional Elective I	PE	3	3	0	0	3
6.		Open Elective I*	PE	3	3	0	0	3
PRACTICALS								
7.	FD8511	Food Processing and Preservation Laboratory	PC	4	0	0	4	2
8.	FD8512	Biochemical Engineering Laboratory	PC	4	0	0	4	2
9.	HS8581	Professional Communication	EEC	2	0	0	2	1
TOTAL				29	19	0	10	24

* - Course from the curriculum of the other UG Programmes

SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	FD8601	Food Process Engineering and Economics	PC	3	3	0	0	3
2	FD8602	Baking and Confectionary Technology	PC	3	3	0	0	3
3	FD8603	Fruits and Vegetable Processing Technology	PC	3	3	0	0	3
4		Professional Elective II	PE	3	3	0	0	3
5		Professional Electives III	PE	3	3	0	0	3
6		Professional Electives IV	PE	3	3	0	0	3
PRACTICALS								
7	FD8611	Fruits and Vegetable Processing Technology Laboratory	PC	4	0	0	4	2
8	FD8612	Baking and Confectionary Technology Laboratory	PC	4	0	0	4	2
TOTAL				26	18	0	8	22

SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	FD8701	Dairy Process Technology	PC	3	3	0	0	3
2	FD8702	Food Safety, Quality and Regulation	PC	3	3	0	0	3
3	FD8703	Food Packaging Technology	PC	3	3	0	0	3
4		Professional Elective V	PE	3	3	0	0	3
5		Professional Elective VI	PE	3	3	0	0	3
6		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7	FD8711	Testing of Packaging Materials Laboratory	PC	4	0	0	4	2
8	FD8712	Dairy Process Technology Laboratory	PC	4	0	0	4	2
TOTAL				26	18	0	8	22

* - Course from the curriculum of the other UG Programmes

SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	FD8811	Project Work	EEC	20	0	0	20	10
TOTAL				20	0	0	20	10

TOTAL CREDITS: 179

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I, SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	FD8001	Biology and Chemistry of Food Flavours	PE	3	3	0	0	3
2.	FD8002	Pulse and Oil Seed Technology	PE	3	3	0	0	3
3.	FD8003	Traditional Foods	PE	3	3	0	0	3
4.	GE8071	Disaster Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	FD8004	Process Economics and Industrial Management	PE	3	3	0	0	3
2.	FD8005	Functional Foods and	PE	3	3	0	0	3

		Nutraceuticals						
3.	FD8006	Food Toxicology and Allergy	PE	3	3	0	0	3
4.	FD8007	Spices and Plantation Technology	PE	3	3	0	0	3
5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	FD8008	Food Process Equipment Design	PE	3	3	0	0	3
2.	FD8009	Cereal Technology	PE	3	3	0	0	3
3.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
4.	BT8091	Instrumentation and Process Control	PE	3	3	0	0	3
5.	BT8071	Biological Spectroscopy	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	FD8010	Meat, Fish and Poultry Processing Technology	PE	3	3	0	0	3
2.	GE8073	Fundamentals of Nanoscience	PE	3	3	0	0	3
3.	FD8011	Food Plant Design	PE	3	3	0	0	3
4.	FD8012	Speciality Foods	PE	3	3	0	0	3
5.	FD8013	Entrepreneurship	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	FD8014	Beverage Technology	PE	3	3	0	0	3
2.	FD8015	Post Harvest Technology	PE	3	3	0	0	3
3.	FD8016	Milling Technology	PE	3	3	0	0	3
4.	FD8017	Creativity, Innovation and New Food Product Development	PE	3	3	0	0	3
5.	BT8751	Downstream Processing	PE	3	3	0	0	3
6.	GE8074	Human Rights	PE	3	3	0	0	3
7.	GE8072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	FD8018	Management of Food Waste	PE	3	3	0	0	3

2.	FD8019	Food Safety Management Systems	PE	3	3	0	0	3
3.	FD8020	Genetic Engineering and Genetically Modified Foods	PE	3	3	0	0	3
4.	FD8021	Storage Engineering	PE	3	3	0	0	3
5.	FD8022	Technology of Fat and Oil	PE	3	3	0	0	3
6.	FD8023	Emerging Technologies in Food Processing	PE	3	3	0	0	3
7.	GE8077	Total Quality Management	PE	3	3	0	0	3

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6.	PH8254	Physics of Materials	BS	3	3	0	0	3
7.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
8.	MA8391	Probability and Statistics	BS	4	4	0	0	4

S. No.	COURSE	COURSE TITLE	CATE	CONTACT	L	T	P	C
--------	--------	--------------	------	---------	---	---	---	---

ENGINEERING SCIENCES (ES)

	CODE		GORY	PERIODS				
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
5.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	BT8291	Microbiology	PC	3	3	0	0	3
2.	FD8201	Biochemistry	PC	3	3	0	0	3
3.	BT8261	Biochemistry Laboratory	PC	4	0	0	4	2
4.	FD8301	Introduction to Food Processing	PC	3	3	0	0	3
5.	FD8302	Food Process Calculations	PC	4	3	2	0	4
6.	FD8303	Food Microbiology	PC	3	3	0	0	3
7.	FD8304	Principles of Fluid Mechanics	PC	4	3	2	0	4
8.	FD8305	Food Chemistry and Nutrition	PC	3	3	0	0	3
9.	FD8311	Food Microbiology Laboratory	PC	4	0	0	4	2
10.	FD8312	Food Chemistry and Nutrition Laboratory	PC	4	0	0	4	2
11.	FD8401	Food Analysis	PC	3	3	0	0	3
12.	FD8491	Fundamentals of Heat and Mass Transfer	PC	4	3	2	0	4
13.	FD8402	Thermodynamics	PC	3	3	0	0	3
14.	FD8403	Unit Operations for Food Industries	PC	3	3	0	0	3
15.	FD8411	Food Analysis Laboratory	PC	4	0	0	4	2
16.	FD8412	Unit Operations Laboratory	PC	4	0	0	4	2
17.	FD8501	Food Additives	PC	3	3	0	0	3
18.	FD8502	Biochemical Engineering for Food Technologists	PC	4	4	0	0	4
19.	FD8503	Refrigeration and Cold Chain Management	PC	3	3	0	0	3
20.	FD8504	Food Processing and Preservation	PC	3	3	0	0	3
21.	FD8511	Food Processing and Preservation Laboratory	PC	4	0	0	4	2
22.	FD8512	Biochemical Engineering Laboratory	PC	4	0	0	4	2
23.	FD8601	Food Process Engineering and Economics	PC	3	3	0	0	3
24.	FD8602	Baking and Confectionary	PC	3	3	0	0	3

		Technology						
25.	FD8603	Fruits and Vegetable Processing Technology	PC	3	3	0	0	3
26.	FD8611	Fruits and Vegetable Processing Technology Laboratory	PC	4	0	0	4	2
27.	FD8612	Baking and Confectionary Technology Laboratory	PC	4	0	0	4	2
28.	FD8701	Dairy Process Technology	PC	3	3	0	0	3
29.	FD8702	Food Safety, Quality and Regulation	PC	3	3	0	0	3
30.	FD8703	Food Packaging Technology	PC	3	3	0	0	3
31.	FD8711	Testing of Packaging Materials Laboratory	PC	4	0	0	4	2
32.	FD8712	Dairy Process Technology Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS8381	Interpersonal Skills/Listening and Speaking	EEC	2	0	0	2	1
2.	HS8461	Advanced Reading And Writing	EEC	2	0	0	2	1
3.	HS8581	Professional Communication	EEC	2	0	0	2	1
4.	FD8811	Project Work	EEC	20	0	0	20	10

SUMMARY

S. No	Subject Area	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4	-	3	-	-	-	-	11
2	BS	12	7	4	4	-	-	-	-	27
3	ES	9	6	-	-	-	-	-	-	15
4	PC	-	8	21	17	17	13	13	-	89
5	PE	-	-	-	-	3	9	6	-	18
6	OE	-	-	-	-	3	-	3	-	6
7	EEC	-	-	1	1	1	-	-	10	13
Total		25	25	26	25	24	22	22	10	179

HS8151

COMMUNICATIVE ENGLISH

L T P C
4 0 0 4

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 listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting- **Writing-** completing sentences - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development-** Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Reading- short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT

12

Reading- comprehension-reading longer texts- reading different types of texts- magazines
Writing- letter writing, informal or personal letters-e-mails-conventions of personal email-
Listening- listening to dialogues or conversations and completing exercises based on them.
Speaking- speaking about oneself- speaking about one's friend- **Language development-**
Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING

12

Reading- longer texts- close reading –**Writing-** brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks-conversations- **Speaking** – participating in conversations- short group conversations-**Language development-**modal verbs- present/ past perfect tense - **Vocabulary development-**collocations-fixed and semi-fixed expressions

TOTAL : 60 PERIODS

OUTCOMES:

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

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. **Academic Writing: A practical guide for students.** New York: Rutledge,2011.
2. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skills for Business English.** Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P. Kiranmai and RajeevanGeeta. **Basic Communication Skills,** Foundation Books: 2013.
4. Means,L. Thomas and Elaine Langlois. **English & Communication For Colleges.** CengageLearning ,USA: 2007.
5. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005.

MA8151

ENGINEERING MATHEMATICS – I

L T P C

4 0 0 4

OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as

single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

Partial differentiation – Homogeneous functions and Euler’s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

UNIT III INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler’s and Legendre’s type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151**ENGINEERING PHYSICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER**9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND FIBER OPTICS**9**

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS**9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conduction in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS**9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS**9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, 2007.

CY8151

ENGINEERING CHEMISTRY

**LT PC
3 0 0 3**

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT

9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse

Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H₂-O₂ fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

GE8151

PROBLEM SOLVING AND PYTHON PROGRAMMING

L T P C

3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures -- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING

9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS

9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS

9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES

9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES

9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

GE8152

ENGINEERING GRAPHICS

**L T P C
2 0 4 4**

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING

7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of 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- Freehand sketching of multiple views from pictorial views of objects

5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size. The examination will be conducted in appropriate sessions on the same day

GE8161

**PROBLEM SOLVING AND PYTHON PROGRAMMING
LABORATORY**

**L T P C
0 0 4 2**

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS

BS8161	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
(b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

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

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.

3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8TH edition, 2014)

HS8251

TECHNICAL ENGLISH

L T P C
4 0 0 4

OBJECTIVES:

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH

12

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development-** technical vocabulary **Language Development** –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS

12

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing-** interpreting charts, graphs- **Vocabulary Development-** vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

UNIT IV REPORT WRITING 12

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing-** email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--**Vocabulary Development-** finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12

Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey-**Vocabulary Development-** verbal analogies **Language Development-** reported speech

TOTAL :60 PERIODS

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

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016.
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication.** Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, **Project Work**, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations**, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English.** Orient Blackswan: Hyderabad,2015.
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251

ENGINEERING MATHEMATICS – II

**L T P C
4 0 0 4**

OBJECTIVES :

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES :

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

magnetoresistance materials.

UNIT V NEW MATERIALS AND APPLICATIONS 9

Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene and its properties - Ceramics: types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Biomaterials: hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – conducting, semiconducting and photoresponsive polymers.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the students will able to

- gain knowledge on phase diagrams and various material processing methods,
- acquire knowledge on basics of conducting materials, superconductors and their applications
- get knowledge on the functioning of semiconducting materials and their applications in LED and solar cells,
- understand the functioning of various dielectric and magnetic materials ,
- have the necessary understanding on various advanced materials.

TEXT BOOKS:

1. Balasubramaniam, R. “Callister's Materials Science and Engineering”. Wiley India Pvt. Ltd. 2014.
2. Kasap, S.O. “Principles of Electronic Materials and Devices”. McGraw-Hill Education, 2007.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

REFERENCES

1. Askeland, D. “Materials Science and Engineering”. Brooks/Cole, 2010
2. Raghavan, V. “Materials Science and Engineering : A First course”. PHI Learning, 2015.
3. Smith, W.F., Hashemi, J. & Prakash. R. “Materials Science and Engineering”. Tata Mcgraw Hill Education Pvt. Ltd., 2014.

**BE8252 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
4 0 0 4**

OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 10

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 10

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials

UNIT III BUILDING COMPONENTS AND STRUCTURES 15

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 15

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants -- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

OUTCOMES:

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

- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Shanmugam Gand Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 1996.

REFERENCES:

1. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.1999.
2. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
3. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
4. Venugopal K. and Prahua Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2000.
5. ShanthaKumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.

BT8291

MICROBIOLOGY

L T P C
3 0 0 3

OBJECTIVES

- To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.
- To solve the problems in microbial infection and their control.

UNIT I INTRODUCTION

6

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION

12

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM

12

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS

6

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY

9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.

OBJECTIVE

- To enable students learn the fundamentals of Biochemical Processes and Biomolecules.

UNIT I INTRODUCTION TO BIOMOLECULES**5**

Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules, chemical nature of water, pH and biological buffers.

UNIT II STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES**15**

Carbohydrates (mono, di, oligo & polysaccharides) mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate.

Lipids: Fatty acids, glycerol, triacylglycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids. Inherited metabolic disorders of Lipid-metabolism-Tay-Saach's disease, Niemann-Pick's disease and Gaucher's disease. Cholesterol, steroids, Bile acids and salts, Gluco-and Mineralo-corticosteroids. Aldosterone, cortisone and synthetic derivative-prednisolone. Androgens-testosterone, Estrogens- estrone, estradiol and progesterone. Prostaglandins and their functions. LDL, HDL and VLDL. Cardiovascular disease and correlation with circulating lipid and lipoprotein concentration

Amino Acids, Peptides, and Proteins. Classification based on side-chain properties. Structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determination of primary structure.

Nucleic acids: Purines, pyrimidines, nucleosides, nucleotides, Chargaff's Rules. Base pairing, A-T and G-C, mRNA, rRNA and tRNA., Watson-Crick structure of DNA. reactions, properties, Tm and hypochromicity, Measurement of DNA and RNA. Nucleoprotein complexes

UNIT III METABOLISM CONCEPTS**5**

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION**15**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V CASE STUDIES**5**

Case study on overproduction of primary and secondary metabolites - glutamic acid, threonine , lysine, methionine, isoleucine, propionic acid and ethanol.

TOTAL: 45 PERIODS**OUTCOMES**

- To ensure students have a strong foundation in the structure and reactions of Biomolecules.

- To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- To correlate Biochemical processes with Biotechnology applications.

TEXT BOOKS

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox
2. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied Ltd., 2006.
3. Rastogi, S.C. "Biochemistry" 2nd Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., et al., "Outlines of Biochemistry" 5th Edition, John Wiley & Sons, 1987.
5. Outlines of biochemistry, 5th Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 1987.

REFERENCES

1. Berg, Jeremy M. et al. "Biochemsitry", 6th Edition, W.H. Freeman & Co., 2006.
2. Murray, R.K., etal "Harper's Illustrated Biochemistry", 27th Edition, McGraw-Hill, 2006.
3. Voet, D. and Voet, J.G., "Biochemistry", 3rd Edition, John Wiley & Sons Inc.,2004.

GE8261

ENGINEERING PRACTICES LABORATORY

L T P C
0 0 4 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

13

Buildings:

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

18

Welding:

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

Basic Machining:

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

Sheet Metal Work:

- (a) Forming & Bending:
- (b) Model making – Trays and funnels.
- (c) Different type of joints.

Machine assembly practice:

- (a) Study of centrifugal pump
- (b) Study of air conditioner

Demonstration on:

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

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

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings

- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

AIM

- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.) and laboratory analysis of the same in the body fluids.

EXPERIMENTS

- General guidelines for working in biochemistry lab (theory)
- Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
- Accuracy, precision, sensitivity and specificity (theory)
- Preparation of buffer –titration of a weak acid and a weak base.
- Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
- Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
- Protein estimation by Biuret and Lowry's methods.
- Protein estimation by Bradford and spectroscopic methods.
- Extraction of lipids and analysis by TLC.
- Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
- Enzymatic assay: phosphatase from potato.
- Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

Equipment Needed for 20 Students

Autoclave	1
Hot Air Oven	1
Incubators	2
Light Microscopes	4
Incubator Shaker	1
Colorimeter	2
Laminar Flow Chamber	2
Glassware, Chemicals, Media as required	

TOTAL: 60 PERIODS**TEXT BOOKS**

- Practical Biochemistry by R.C. Gupta and S. Bhargavan.
- Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCES

- Harpers Biochemistry Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Conneticut.
- Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers

OBJECTIVE:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS**12**

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES**12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS**12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS**12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS**OUTCOMES:**

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

FD8301

INTRODUCTION TO FOOD PROCESSING

L T P C

3 0 0 3

OBJECTIVE:

- The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE

9

Source of food - 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, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

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 gas 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

12

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 IN VARIOUS PROCESSES**6**

Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V FOOD HYGIENE**9**

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 PERIODS**OUTCOMES:**

On completion of the course the students are expected to

- Be aware of the different methods applied to processing foods.
- Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice". Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

FD8302**FOOD PROCESS CALCULATIONS****L T P C****3 2 0 4****OBJECTIVE:**

- Units and Dimensions: Basic and derived units, 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

UNIT II**9+6**

Fundamental Calculations and Humidity: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT III**9+6**

Basic Principles of Stoichiometry - Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use –Data sources, Humidity and applications. Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching.

UNIT IV**9+6**

Energy Balance: 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.

UNIT V**9+6**

Enthalpy Changes: 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.

TOTAL: 75 PERIODS

(Use of Psychometric chart is permitted in the examination)

TEXT BOOKS:

1. Bhatt, B.L and Vora, S.M., "Stoichiometry", Third Edition, McGraw-Hill, New York, 2004.
2. Gavhane, K.A "Introduction to Process Calculations" (Stoichiometry) NiraliPrakashan Publications, Pune, 2009.

REFERENCES:

1. Venkataramani, V. and Anantharaman, N., "Process Calculations" , Prentice Hall of India, New Delhi, 2011.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", Eighth Edition, Prentice Hall India, New Delhi, 2015.

FD8303**FOOD MICROBIOLOGY****L T P C****3 0 0 3****OBJECTIVES:**

- The course aims to develop the knowledge of students in the basic area of Food Microbiology.
- This is necessary for effective understanding of food processing and technology subjects as well as food safety.
- This course will enable students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.

UNIT I ROLE OF MICROBES IN SPOILAGE OF FOODS**9**

Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products.

UNIT II CONTROL OF MICROBES IN FOODS**9**

Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.

UNIT III MICROBES IN FOOD FERMENTATIONS**9**

Microbes of importance in food fermentations, – homo & hetero-fermentative bacteria, yeasts & fungi; biochemistry of fermentations – pathways involved, lactic acid bacteria fermentation and starter cultures, alcoholic fermentations -yeast fermentations - characteristics and strain selection, fungal fermentations. microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.

UNIT IV MICROBIAL AGENTS OF FOOD BORNE ILLNESS**9**

Food borne infections and food poisoning, microbial toxins, Gram Negative and Gram positive food borne pathogens; toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.

UNIT V MICROBIAL EXAMINATION OF FOODS**9**

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; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulinum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

TOTAL: 45 PERIODS

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, food preservation.
- Understand the role of pathogens in food borne infections. • Understand the methods used to detect pathogens in foods.

TEXT BOOKS:

1. Banwart, G.J. "Basic Food Microbiology" 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. "Food Microbiology". MJP Publishers, Chennai, 2007.
3. Jay, J.M. "Modern Food Microbiology". 4th Edition. CBS Publishers, 2003.
4. Adams, M.R. and M.O. Moss. "Food Microbiology". New Age International, 2002
5. Khetarpaul, Neelam. "Food Microbiology" Daya Publishing House, 2006.

REFERENCES:

1. Montville, Thomas J. and Karl R. Matthews "Food Microbiology: An Introduction". ASM Press, 2005
2. Ray, Bibek and ArunBhunia. "Fundamental Food Microbiology" 4th Edition, CRC Press, 2008
3. Pawsey, R. K. "Case Studies in Food Microbiology for Food Safety and Quality". The Royal Society of Chemistry, 2001.
4. Forsythe, S.J. "The Microbiology of Safe Food". Blackwell Science, 2000.
5. Doyle, Michael P. "Food Microbiology: Fundamentals and Frontiers". 2nd Edition, ASM Press, 2001.

FD8304

PRINCIPLES OF FLUID MECHANICS

L T P C

3 2 0 4

OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.

UNIT I PROPERTIES OF FLUIDS

9+6

Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity surface tension – capillarity. Fluid pressure and measurement –

simple, differential and micro manometers - Mechanical gages – calibration. Hydrostatic forces on surfaces – total pressure and centre of pressure - Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy – meta centre – metacentric height

UNIT II FLUID FLOW ANALYSIS

9+6

Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational – circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube – path line – streak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.

UNIT III FLOW MEASUREMENTS

9+6

Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter rota meter – elbow meter pitot tube – Orifice – sharp edged orifice discharging free – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William's formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of valves

UNIT IV OPEN CHANNEL FLOW

9+6

Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force - critical flow – computation. Flow measurement in channels – notches – rectangular, Cippollette and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.

UNIT V DIMENSIONAL ANALYSIS & PUMPS

9+6

Dimensional analysis – concept of geometric, kinematic and dynamic similarity. Important nondimensional numbers – Reynolds, Froude, Euler, Mach and Weber. Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming

TOTAL: 75 PERIODS

OUTCOMES:

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

TEXT BOOKS:

1. Modi, P.N. and Seth S.M. "Hydraulics and fluid mechanics". Standard Publishers Distributors, New Delhi, 2010
2. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9th ed) Tata McGraw Hill, New Delhi, 1998

REFERENCES:

1. Bansal, R.K., "A text book of fluid mechanics and hydraulic machinery", Laxmi publications (P) Ltd., New Delhi, 2002
2. Grade, R.J., "Fluid mechanics through problems". Wiley eastern Ltd., Madras, 2002
3. Jain A. K. "Fluid Mechanics". Khanna Publishers 1995.

5. Jagadish Lal, "Hydraulic machines". Metropolitan book house, New Delhi, 2000
6. Michael, A.M. "Irrigation Theory and practice", Vikas publishing house, New Delhi, 2008

FD8305

FOOD CHEMISTRY AND NUTRITION

L T P C

3 0 0 3

OBJECTIVE:

- The course aims to develop the knowledge of students in the basic area of Food Chemistry. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

UNIT I AN OVERVIEW OF NUTRITION 9

Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis; Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT II CARBOHYDRATES 9

Simple Sugars: mono and disaccharides, Properties, Caramelization, Maillard reaction; Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch- Structure, Properties, Functional role in food system, Modified starches, Resistant starch, Starch hydrolysates, Applications in food industry. Non-starch polysaccharides: Pectins, Gums & Hydrocolloid, Fiber - Cellulose & hemicellulose; Food sources, functional role and uses in foods. Digestion and absorption of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM

UNIT III PROTEINS & LIPIDS 9

Review of protein structure & conformation; Properties & reactions of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation & stabilization, gel formation, emulsifying effect, thickening & binding, amino acids in Maillard reaction, denaturation; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods. Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, 44 isomerisation, unsaturation; Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization; Hydrolytic rancidity & oxidative rancidity; radiolysis Shortening power of fats, tenderization, emulsification, frying - smoke point, auto oxidation,

polymerization; Fat replacements; Food sources, functional role and uses in foods. Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Digestion and absorption of proteins; Functions of proteins; amino acids, Recommended intakes of proteins, Deficiency- short term and long term effects.

UNIT IV WATER AND MICRONUTRIENTS 9

Chemistry, physical properties, free, bound & entrapped water, water activity. Drinking water, mineral water, water hardness, water quality for food processing. Mineral & vitamin content of foods- Food and Pharmaceutical grades; Recommended daily intake, toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

UNIT V METABOLISM, ENERGY BALANCE AND BODY COMPOSITION 9

Review of catabolic and anabolic pathways of glucose, fats and amino acids; Definition, units, calorific value of foods – bomb calorimeter; energy requirements – basal metabolism, specific dynamic action of foods, energy balance, 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 behaviors toward weight control.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to

- Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
- Be able to understand and identify the non-nutritive components in food, naturally present.
- Understand and use effectively, food composition tables and databases.
- Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition

TEXT BOOKS:

1. 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.
7. Gropper, Sareen S. and Jack L. Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

REFERENCES:

1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. Damodaran, S., K.L. Parkin and O.R. Fennema. "Fennema's Food Chemistry". 4th Edition, CRC Press, 2008
3. Belitz, H.-D, Grosch W and Schieberle P. "Food Chemistry", 3rd Rev. Edition, Springer-Verlag, 2004.
4. Walstra, P. "Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005.

FD8311

FOOD MICROBIOLOGY LABORATORY

LT P C

0 0 4 2

OBJECTIVES:

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

LAB EXPERIMENTS:

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media- Types and Use; Preparation of Nutrient broth and agar
2. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
3. Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining
4. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products TVC
5. Microbiological Quality of Water (MPN)
6. Microbiological quality of milk
7. Enumeration of Lactic acid bacteria from fermented foods
8. Yeast & Mould count from fruits
9. Enumeration of spores from pepper
10. Inhibitory effect of spices on microbial load in fish & flesh foods
11. Enumeration & Isolation of E. coliform processed meat/chicken
12. Thermal destruction of microbes: TDT & TDP
13. Enumeration & Isolation of Staphylococci from ready to eat street foods
14. Effect of cleaning and disinfection on microbial load

TOTAL:60 PERIODS

OUTCOMES:

- Complete understanding of isolation, characterization of various microbes associated with foods and food groups.
- Familiarize with microbiological techniques for the study of foods.
- Better understanding of methods to detect pathogens in foods.

Equipment Needed for 30 Students

Autoclave	1
Static Incubators	1
Light Microscopes	5
Incubator Shaker	1
Colorimeter	2
Lamina Flow Chamber	3
Refrigerator	2
Colony counter	5
Water bath	4
pH meter	2
Weighing Balance	2
Analytical Balance	1
Glassware / Chemicals / Media as required	

OBJECTIVES:

- To study and understand the physical and chemical properties of foods
- This course will enable the students to – be familiar with nutrient composition of foods
- To gain knowledge in quantitative methods in assessing nutritional status of individuals and groups

EXPERIMENTS:

1. Estimation of Viscosity of foods
2. Properties of solutions- sugar & salt
3. Preparation of emulsions
4. Solubility, specific gravity, Refractive index and Oxidative rancidity of fats and oils
5. Iso-electric precipitation of casein, Effect of rennin on milk proteins
6. Gelling properties of starch
7. Study of gluten formation
8. Enzymatic Browning in foods
9. Enzymatic hydrolysis of sucrose and measurement of optical rotation
10. Calculation and Computing of nutrient composition of foods
11. Nutritional anthropometry - Standards for reference – WHO Growth Charts from birth to 18 years, Body Mass Index and reference value
12. 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 callipers
13. Calculation of energy balance of individuals based on 3 day dietary recall.
14. Dietary survey of a group of individuals/community
15. Comparison of Food Composition data bases

TOTAL: 60 PERIODS**OUTCOMES:**

- Better understanding the physical and chemical properties of food. Familiarize in precipitation of casein and gelation of starch.
- Understanding the food groups, constituents of food, energy from food
- Exposing to nutritional assessment, food constituents and their daily dietary allowances

Equipment Needed for 30 Students

Viscometer	2
Vortex	5
Pycnometer	5
Texture Analyser	1
Refractometer	2
Soxhlet	3
Muffle Furnace	1
Polarimeter	1
pH meter	3
Heating mantle	5
Weighing balance	2
Thermometer	5
Water bath	4
Colorimeter	5
Hot air oven	1
Analytical Balance	1
Moisture Balance	1

Stadiometer	2
Skin fold caliper	5
Weight machine	2
Glassware / Chemicals	As required

HS8381	INTERPERSONAL SKILLS/LISTENING AND SPEAKING	L	T	P	C
		0	0	2	1

OBJECTIVES: The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

UNIT I

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:

1. Brooks, Margret. **Skills for Success. Listening and Speaking. Level 4** Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. **Speak Now Level 3.** Oxford University Press, Oxford: 2010

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. **Communicative English for Engineers and Professionals.** Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. **Practical English Classroom.** Oxford University Press: Oxford, 2014.
3. Vargo, Mari. **Speak Now Level 4.** Oxford University Press: Oxford, 2013.
4. Richards C. Jack. **Person to Person (Starter).** Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. **Role Play.** Oxford University Press: Oxford, 2014

MA8391

PROBABILITY AND STATISTICS

L T P C

4 0 0 4

OBJECTIVE:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES

12

Probability – The axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES

12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS

12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS

12

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2² factorial design.

UNIT V STATISTICAL QUALITY CONTROL

12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students will be able to:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

FD8401

FOOD ANALYSIS

L T P C

3 0 0 3

OBJECTIVE:

- To expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.

UNIT I INTRODUCTION

10

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture

OBJECTIVE:

- To understand the principles and applications of heat and mass transfer operations.

UNIT I HEAT TRANSFER – CONDUCTION**9+6**

Basic transfer processes – heat, mass and momentum – heat transfer process - conductors and insulators - conduction – Fourier’s fundamental equation – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – extended surfaces (fins) — solving problems in heat transfer by conduction.

UNIT II HEAT TRANSFER - CONVECTION**9+6**

Newton Rikhman’s law – film coefficient of heat transfer - convection – free and forced convection - dimensional analysis and its application – factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in heat transfer by convection.

UNIT III HEAT TRANSFER – HEAT EXCHANGER**9+6**

Heat exchangers – parallel, counter and cross flow – evaporator and condensers - Logarithmic Mean Temperature Difference – overall coefficient of heat transfer – tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger – applications of heat exchangers - solving problems in heat exchangers.

UNIT IV HEAT TRANSFER: RADIATION**9+6**

Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff’s law – Planck’s law - Stefan-Boltzman’s law – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.

UNIT V MASS TRANSFER**9+6**

Mass transfer – introduction – Fick’s law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross sectional area and diffusion coefficients for gases - molecular diffusion in liquids, biological solutions and gels.

TOTAL: 75 PERIODS**OUTCOME:**

- To understand and apply the principles in heat transfer phenomena To understand and apply the principles in mass transfer phenomena To design heat and mass transfer equipments.

TEXT BOOKS:

1. Bellaney, P.L. “Thermal Engineering”. Khanna Publishers, New Delhi, 2001
2. Geankoplis C.J. “Transport Process and Unit Operations”. Prentice-Hall of India Private Limited, New Delhi, 1999

REFERENCES:

1. Jacob and Hawkins. “Elements of Heat Transfer”. John Willey and Sons Inc. New York, 1983
2. Eckert, E.R.G. “Heat and Mass Transfer”. McGraw Hill Book Co., New York, 1981
3. Holman, E.P. “Heat Transfer”. McGraw-Hill Publishing Co. New Delhi, 2001

4. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004
5. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, McGraw Hill, 2003.

GE8291

ENVIRONMENTAL SCIENCE AND ENGINEERING

L T P C

3 0 0 3

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION

8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES

10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture

and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

FD8402

THERMODYNAMICS

L T P C

OBJECTIVE:

3 0 0 3

- To introduce fundamental thermodynamic principles and their application.

UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS 9

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

UNIT II SOLUTION THERMODYNAMICS 9

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

UNIT III PHASE EQUILIBRIA 9

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION 9

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

TOTAL: 45 PERIODS

OUTCOME:

- Students will learn laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

TEXT BOOKS:

1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", VI Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.
3. Christiana D. Smolke, "The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

REFERENCE:

1. Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley, 1989.

**FD8403 UNIT OPERATIONS FOR FOOD INDUSTRIES L T P C
3 0 0 3**

OBJECTIVE:

- To understand the principles involved in separation methods.

UNIT I EVAPORATION AND CONCENTRATION 9

Unit operations in food processing –conservation of mass and energy – overall view of an engineering process-dimensions and units – dimensional and unit consistency – dimensionless ratios-evaporation – definition – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator

UNIT II MECHANICAL SEPARATION 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 separations – rate of separations – liquid – liquid separation – centrifuge equipment.

UNIT III SIZE REDUCTION 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 equipments – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.

UNIT IV CONTACT EQUILIBRIUM SEPARATION 9

Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions-calculation of separation in contact – equilibrium processes-gas absorption – rate of gas absorption – stage – equilibrium gas – absorption equipment-properties of tower packing – types – construction – flow through packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator – continuous leaching – decantation systems – extraction towers-washing – equipments

UNIT V CRYSTALLIZATION AND DISTILLATION 9

Crystallization – equilibrium -solubility and equilibrium diagram – rate of crystal growth – equilibrium crystallization-crystallization equipment – classification – construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation – binary mixtures – flash and differential distillationsteam distillation – theory – consumption – continuous distillation with rectification – vacuum distillation - batch distillation – operation and process – advantages and limitations-distillation equipments – construction and operation – factors influencing the operation.

TOTAL: 45 PERIODS

OUTCOME:

- To understand Principles of separation methods used in the process industry. To appreciate different equipments developed for separation.

TEXT BOOKS:

1. Geankopolis, C.J. “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.

- McCabe W.L., Smith J.C. "Unit Operations in Chemical Engineering", 7th Edition, McGraw – Hill Int., 2001,
- Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
- Geankoplis C.J.1999. Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi.

REFERENCE:

- Richardson, J.E. et al., "Coulson & Richardson's Chemical Engineering" Vol.2 (Practical Technology & Separation Processes") 5th Edition, Butterworth – Heinemann / Elsevier, 2003.
- Coulson, J.M and J.F. Richardson, "Chemical Engineering". Volume I to V. The Pergamon Press. New York, 1999
- McCabe, W.L., J.C.Smith and P.Harriot, "Unit Operations of Chemical Engineering". McGrawHill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001
- Sahay, K. M. and K.K.Singh, "Unit operation of Agricultural Processing", Vikas Publishing House Pvt. Ltd., New Delhi, 2004

FD8411

FOOD ANALYSIS LABORATORY

L T P C

0 0 4 2

OBJECTIVE:

- Analysis of foods and food products for chemical components, compliance to standards; detection of adulterants in foods.

LAB EXPERIMENTS:

- Determination of moisture in spices powder by distillation method and Hot air oven method.
- Determination of total fat, protein in milk and milk products.
- Rancidity test for fried foods to assess primary and secondary oxidative products.
- Determination of Vitamin C in fruit juices.
- Estimation of synthetic Food colour in sweets, confectioneries and beverages.
- Determination of Iron content in foods.
- Determination of Iodine content in iodized salt.
- Detection of Annatto, lead, MSG, sulphur-di-oxide, Emulsifiers and stabilizers in food products.
- Detection of anti oxidant in foods.
- Determination of soluble and insoluble fibre in foods.
- Detection of adulterants in edible oil and ghee.
- Column chromatographic separation of colours
- The identification of sugars in fruit juice using TLC.

TOTAL: 60 PERIODS

OUTCOMES:

- Better understanding in analysis of foods and food products for chemical components. Knowing standards for food products.
- Obtain knowledge of adulterants in foods.

Equipment Needed for 30 Students

Soxhlet apparatus	5
Kjeldahl apparatus	2
UV spectrophotometer	1

Colour comparator	1
Water bath	2
pH meter	3
Fume hood	1
Dean and stark apparatus	1
Weighing balance	1
Hot air oven	1
Simple distillation unit	2
TLC paper strips As required	
Glassware / Chemicals As required	

TEXT BOOKS:

1. Skoog, D.A. et al. "Principles of Instrumental Analysis", V Edition, Thomson / Brooks – Cole, 1998.
2. Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.
3. Willard, H.H. et al. "Instrumental Methods of Analysis", VII Edition, CBS, 1986.
4. Ewing, G.W. "Instrumental Methods of Chemical Analysis", V Edition, McGraw-Hill, 1985.

FD8412

UNIT OPERATIONS LABORATORY

L T P C

0 0 4 2

OBJECTIVE:

- To develop knowledge in handling basic operation equipment's

EXPERIMENTS:

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Determination of economy and thermal efficiency of rotary flash evaporator
3. Solving problems on single and multiple effect evaporator
4. Determination of separation efficiency of centrifugal separator.
5. Determination of collection efficiency in cyclone separator.
6. Determination of efficiency of liquid solid separation by filtration.
7. Determination of absorption efficiency in a packing tower
8. Determination of porosity, coefficient of friction and angle of repose of grains.
9. Determination of particle size of granular foods by sieve analysis.
10. Determination of performance characteristics in size reduction using the burr mill.
11. Determination of energy requirement in size reduction using the ball mill and hammer mill.
12. Performance evaluation of pin mill and hammer mill.
13. Performance evaluation of a steam distillation process.
14. Visit to a solvent extraction, sugar industry.

TOTAL: 60 PERIODS

Equipment Needed for 30 Students

Orifice meter	1
Venturi meter	1
Rotameter	1
Packed column	1
Centrifugal separator	1
Steam distillation unit	2
Fluidized bed column	1
Rotary flash evaporator	1

Cyclone separator	1
Ball mill	1
Hammer mill	1
Burr mill	1
Pin mill	1
Glassware / Chemicals	As required

OUTCOMES:

Upon completion of this practical course the student will

- Have knowledge on the basic principles of chemical engineering and its applications.
- Be able to apply the skill of material balance and energy balance in unit operations unit process

HS8461

ADVANCED READING AND WRITING

L	T	P	C
0	0	2	1

OBJECTIVES:

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT I

Reading - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title
Writing-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph

UNIT II

Reading-Read for details-Use of graphic organizers to review and aid comprehension **Writing**- State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

UNIT III

Reading- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-**Writing**- Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

UNIT IV

Reading- Genre and Organization of Ideas- **Writing**- Email writing- visumes – Job application-project writing-writing convincing proposals.

UNIT V

Reading- Critical reading and thinking- understanding how the text positions the reader- identify

Writing- Statement of Purpose- letter of recommendation- Vision statement

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

TEXT BOOKS:

1. Gramer F. Margot and Colin S. Ward **Reading and Writing (Level 3)** Oxford University Press: Oxford, 2011
2. Debra Daise, CharlNorloff, and Paul Carne **Reading and Writing (Level 4)** Oxford University Press: Oxford, 2011

REFERENCES:

1. Davis, Jason and Rhonda Llss.**Effective Academic Writing (Level 3)** Oxford University Press: Oxford, 2006
2. E. Suresh Kumar and et al. **Enriching Speaking and Writing Skills.** Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al. **Inspired to Write. Readings and Tasks to develop writing skills.** Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. **Critical Reading and Writing.** Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham. **The Professional Writing Guide: Knowing Well and Knowing Why.** Business & Professional Publishing: Australia, 2004

FD8501

FOOD ADDITIVES

L T P C

3 0 0 3

OBJECTIVE:

- To expose the students to the use of different chemical additives in foods during food processing and preservation

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 of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codex standards for food additives, 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 (HLB), 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 ARTIFICIAL 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 PERIODS

OUTCOMES:

- To understand the principles of chemical preservation of foods
- To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
- To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

TEXT BOOKS:

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

REFERENCES:

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

FD8502 BIOCHEMICAL ENGINEERING FOR FOOD TECHNOLOGISTS L T P C

4 0 0 4

OBJECTIVES:

- To understand the Enzyme kinetics, Inhibition kinetics, Immobilization
- To understand the concept of basic fermentation processes and its control systems etc.
- To get a practical knowledge about running the fermenter and its scale – up and modes of operation etc.

UNIT I INTRODUCTION TO ENZYME 12

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 12

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeuxwyman model, ph and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION 9

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

UNIT IV OVERVIEW OF FERMENTATION PROCESSES 12

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT V RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 15

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

TOTAL: 60 PERIODS

OUTCOMES:

The student will be able to

- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization Understand the concept of basic fermentation processes and its application during scaleup operations.

TEXT BOOKS:

1. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals”, 2nd Edition, McGraw Hill, 1986.
2. Blanch, H.W. and D.S. Clark “Biochemical Engineering”, Marcal Dekker, Inc., 1997.
3. Lee, James M. “Biochemical Engineering”, Prentice – Hall, 1992.

REFERENCES:

1. Palmer, Trevor “Enzymes: Biochemistry, Biotechnology, Clinical Chemistry”, Affiliated East-West Press Pvt. Ltd., 2004.
2. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
3. Wiseman, Alan “Handbook of Enzyme Biotechnology”, 3rd Edition, Ellis Harwood Publications, 1999.
4. Hartmeier, Winfried “Immobilized Biocatalysts: An Introduction”, Springer –Verlag, 1986

OBJECTIVES:

- To understand the underlying principles of operation in different Refrigeration & cold storage systems and its components.
- To provide knowledge on design aspects of cold storage systems

UNIT I REFRIGERATION PRINCIPLES 9

Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - simple vapour 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 – chloroflouro 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 & 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

What is cold chain? Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life; just – in-time deliveries; Temperature limits;-in various countries-Europe, US, Australia etc; Chilling and freezing;- Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time –temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc; Thaw indicators.

TOTAL: 45 PERIODS**OUTCOME:**

- Upon completion of this course, the students will be able to demonstrate the operations in different Refrigeration & cold storage systems and also able to design Refrigeration & cold storage systems.

TEXT BOOKS:

1. Anand, M.L. “ Refrigeration& Air-Conditioning”. Asian Books Pvt., Ltd., 2002.
2. Sun, Da-Wen. “ Advances in Food Refrigeration”. Leatherhead Publishing, 2001.
3. Kennedy, Christopher J. “Managing Frozen Foods”. CRC / Woodhead Publishing, 2000.
4. James, S.J. and C. James. “ Meat Refrigeration”. CRC / Woodhead Publishing, 2002.

5. Stringer, Mike and C. Dennis. "Chilled Foods: A Comprehensive Guide". 2nd Edition, CRC / Woodhead Publishing, 2002.

REFERENCES:

1. Evans, Judith. "Frozen Food Science and Technology". Wiley-Blackwell, 2008.
2. Hui, Y.H. et al., " Handbook of Frozen Foods". Marcel Dekker, 2004.

FD8504	FOOD PROCESSING AND PRESERVATION	L T P C
		3 0 0 3

OBJECTIVE:

- 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 of process time temperature-schedules.

UNIT II	CANNING OF FOOD PRODUCTS	9
----------------	---------------------------------	----------

Newer methods of thermal processing; batch and continuous; application of infra-red microwaves; ohmic heating; 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 air-water mixtures. Psychrometric chart, freezing and cold storage. freeze concentration, dehydro-freezing, 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 PERIODS

OUTCOMES:

To understand the principles of food processing and preservation.

- 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.
- 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-Sorensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.

FD8511

FOOD PROCESSING AND PRESERVATION LABORATORY

L T P C

0 0 4 2

OBJECTIVES:

To develop skills related to

- Preservation of foods
- Use of various techniques and additives for food processing and Preservation

EXPERIMENTS:

1. Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
2. Refrigeration and Freezing of vegetables and fruits
3. Drying of vegetables and fruits with and without additives - Drying rate studies including, constant rate and falling rate periods and the effects of various factors on them.
4. Osmotic drying of foods with salt and sugar.
5. Canning & bottling of vegetable and fruit products
6. Filtration and concentration of fruit juices
7. Production of extruded products.
8. Spray drying of juices/milk
9. Pasteurization of milk
10. Retort processing of foods
11. Determination of Water vapor transmission rate of different packaging materials
12. Determination of migration characteristics of packaging materials
13. Determination of tensile and burst strength of given packaging material

TOTAL: 60 PERIODS

Equipment Needed for 30 Students

Plate heat exchanger	1
Refrigerator	2
Deep freezer	1
Tray dryer	1
Hot air oven	1
Refractometer	1
Extruder	1
RO equipment	1
Double seamer machine	1
Canning and bottling unit	1
Pasteurizer	1
Spray dryer	1
Retort unit	1
Thermometer	3

Water vapour permeability tester	1
Tensiometer	1
Viscometer	1
Desiccator	5
Weighing balance	2
Vegetable chopper	1
Glassware/Utensils/Chemicals	As required

OUTCOMES:

- Ability to select the specific preservation technology suitable for a specific food
- Ability to Process the different categories of food

REFERENCES:

1. Rahman, M.S. "Handbook of Food Preservation", Marcel Dekker, 1999.
2. Ranganna, S. "Handbook of Canning and Aseptic Packaging" Vol. I, II & III, Tata McGraw – Hill, New Delhi, 2000
3. Pandey, H. et al., "Experiments in Food Process Engineering". CBS Publishers, 2004.

FD8512

BIOCHEMICAL ENGINEERING LABORATORY

L T P C

0 0 4 2

OBJECTIVE:

- To enable the students to understand the concepts and operation of equipment in handling of enzymes and cultivation of microbes in industrial scale .

EXPERIMENT:

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – gel entrapment, cross linking
5. Preparation of bioreactor, utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, estimation of k_{la} – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of k_{la} – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS:

Estimation of biomass, calculation of specific growth rate, yield coefficient
 PlackettBurman design, response surface methodology
 MichelisMenton parameter, effect of temperature and pH
 Gel entrapment, cross linking
 Dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
 Carbon balancing, gas balancing
 Sulphite oxidation method

OUTCOMES:

- To sterilize a bioreactor
- To operate a bioreactor
- To design experiments to evaluate the performance of the bioreactor.
- To develop enzyme immobilized processes.

REFERENCES:

1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals" II Edition, McGraw – Hill, 1988.
2. Lee, James M. "Biochemical Engineering", PHI, U.S.A, 2009
3. Stanbury, P.F. "Principles of Fermentation Technology", II Edition, Butterworth – Heinemann / Elsevier, 1995.
4. El-Mansi, E.M.T. et al., "Fermentation Microbiology and Biotechnology", II Edition, CRC / Taylor & Francis, 2007.
5. Peppler, H.J. and D. Perlman " Microbial Technology" (vol. I Microbial Processes and Vol. I Fermentation Technology)" II Edition, Academic Press / Elsevier, 2004.

HS8581**PROFESSIONAL COMMUNICATION****L T P C
0 0 2 1****OBJECTIVES:****The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTLA: 30 PERIODS

OUTCOMES:

At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software

1. Globearena
2. Win English

REFERENCES:

1. Butterfield, Jeff **Soft Skills for Everyone**. Cengage Learning: New Delhi, 2015
2. **Interact** English Lab Manual for Undergraduate Students,. OrientBlackSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. **Communication for Professional Success**. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. **Professional Communication**. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. **Soft Skills**. MJP Publishers: Chennai, 2010.

FD8601

FOOD PROCESS ENGINEERING AND ECONOMICS

L T P C

3 0 0 3

OBJECTIVE:

- To expose the students to the fundamental knowledge of food, its properties and different methods of food processing

UNIT I RHEOLOGY AND TEXTURE OF FOOD MATERIALS

9

Concept of rheology, elastic, plastic and viscous behaviour, viscoelasticity, rheological models and constitutive equations. Methods of texture evaluation, subjective and objective measurements. Aerodynamic and hydrodynamic characteristics. Application to separation, pneumatic handling and conveying. Material handling: Material handling machines and conveyors. Pre-treatment unit operations: Cleaning, Dehullingand Dehusking, Sorting & Grading, Peeling, Mixing and Forming.Size reduction and separation. Agitation and Mixing. Mechanical Separations: Centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machines. Filtration: Principles involved in filtration. Pressure and vacuum filtration. Expression: batch and continuous type.. Extraction and Leaching, Crystallization and Distillation: Basic principles involved.

Baking, Roasting and Frying equipment

UNIT II THERMAL PROCESSING

9

Concept of thermo bacteriology: Arrhenius analogy, its application in design. Determination of heat resistance of micro organisms.Thermal processing: Blanching, Pasteurizations and Sterilization - principles, different methods and equipments. Processing in containers, process time, T-evaluation, Design of batch and continuous sterilization. Design and analysis of fermenter. Shelf life: Calculation of shelf life. Shelf life requirements, Deteriorative reactions. Accelerated testing.

Transport properties of barriers. Simulations of product - package environment interaction. Shelf life simulation for moisture, oxygen, and light sensitive products.

UNIT III WATER BINDING AND DRYING 9

Raults Law. Water sorption Isotherms - Hysteresis. Water activity measurement method. Water binding and its effect on enzymatic and non-enzymatic reactions and food texture. Control of water activity and moisture. Permeability: Theoretical considerations. Permeability of gases and vapours. Permeability of multilayer materials. Permeability in relation to packaging requirement of foods. Drying: Principles of drying, drying rate kinetics, Classification, mass and energy balance. Different types of dryers and components - roller, spray, tray, compartment, fluidized bed etc.

UNIT IV METHODS OF FOOD PROCESSING 8

Low Temperature: Freezing of Foods, Types of freezers including, ice cream freezers, Freeze concentration and freeze drying. Freezing curves, phase diagrams, methods of freeze concentration, design problems. Membrane processes: Ultra filtration, Reverse osmosis, Electrodialysis, per-evaporation and micro filtration. High Temperature: Extrusion: Extrusion cookers, cold extrusion, single and twin screw extrusion. Low pressure and high pressure extrusion, properties of Food materials, its significance in equipment design, processing and handling Evaporation: Principles of evaporation, types and selection evaporators, mass and energy balance. Design of single and multiple effect evaporators, recompression heat and mass recovery and vacuum creating devices. Fouling of evaporators and heat exchanges. Non – Thermal Methods: Microwave and Dielectric & Infrared heating: Physical parameters. Heat transfer phenomenon. Equipment and application. Irradiation - Principle and its equipments, Blending and pulverization equipments.

UNIT V LAYOUT AND COST ESTIMATION 8

Technology scaleup -Product and process layout - Expansion and Improvements of Existing Facilities- Inventory control - Cost Indexes - Capacity vis-a-vis Costs - Factored Cost Estimate – Break – even point - Improvements– Module Cost Estimation - Unit Operations Estimate- Detailed Cost Estimate- Accuracy of Estimates- Case Study: Capital Cost Estimation.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will understand the importance of quality control and food packaging in shelf life of foods.
- Understand thermal processing of food and hygiene practices in food industry.

TEXT BOOKS:

1. Toledo, Romeo T. "Fundamentals of Food Process Engineering" II Edition. CBS Publishers, 2000.
2. Fellows P. J "Food Processing Technology" Woodhead Publishing, 1998.
3. Smith P. G "Introduction to Food Process Engineering". Springer, 2005
4. Earle, R.L, "Unit Operations in Food Processing". Pergamon Press. Oxford. U.K, 2003

REFERENCES:

1. Sahay, K. M. and K.K.Singh.. "Unit operation of Agricultural Processing", Vikas Publishing House Pvt. Ltd., New Delhi, 2004
2. Berk, Zeki. "Food Process Engineering and Technology". Elsevier, 2009.

OBJECTIVES:

This course will enable the student to

- Familiarize with the commercial methods of baking bread and recent advances in bakery industry
- Learn microbiological aspects of bakery products, sanitation and hygiene of baking industries.

UNIT I INTRODUCTION TO BAKING 9

Classification of bakery products. Bakery ingredients and their functions-Essential ingredients: Flour, yeast and sour dough, water, salt- Other ingredients: Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants.

UNIT II EQUIPMENTS 9

Introduction to utensils and equipments used in bakery industry with their purpose. Bulk handling of ingredients- Dough mixing and mixers, Dividing, rounding, sheeting, and laminating-Fermentation enclosures and brew equipment - Ovens and Slicers; Extrusion. Rheology of dough-Farinograph, Amylograph, Alveograph and Extensiograph.

UNIT III BREAD MAKING PROCESS 9

The Chemistry of dough Development. Bread making methods- Straight dough/bulk fermentation - Sponge and dough- Activated dough development- Chorley wood bread process- Dough retarding and freezing-emergency No time process. Advantages and disadvantages of various methods of bread-making. Characteristics of good bread: Internal characters; external characters. Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention.

UNIT IV BAKERY PRODUCTS 9

Production of cakes and cookies/biscuits. Types of biscuit dough's –Developed dough, short dough's, semi-sweet, enzyme modified dough's and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking.

UNIT V CONFECTIONERY PRODUCTS 9

Definition, importance of sugar confectionery. General technical aspects of industrial sugar confectionery manufacture - compositional effects. Manufacture methods of high boiled sweets: - Ingredients -.prevention of recrystallization and stickiness Types of confectionery products-Caramel, Toffee and Fudge and other confections:- ingredients - Formulation - Processing method- Quality control- Aerated confectionery- Methods of aeration- Manufacturing process-Chemistry of Hydrocolloids, Hydrocolloid pre treatment Processes -product quality parameters, faults and corrective measures. Spoilage of confectionery products.

TOTAL: 45 PERIODS

OUTCOMES:

- Better understanding of process technology of bakery and confectionery products
- Complete learning - use of sanitation and safety practices in bakery and confectionery production

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. Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition, Blackie Academic and professional, Glasgow,1995.

FD8603**FRUITS AND VEGETABLE PROCESSING TECHNOLOGY****L T P C****3 0 0 3****OBJECTIVES:**

- The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of fruits and vegetables.

UNIT I BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS 8

Ability to identify all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, Morphology, structure and composition of fruit and vegetable. Production and processing scenario of fruits and vegetable: India and World. Scope of Fruit and Vegetable Preservation Industry in India. Present status, constraints and prospectus.

UNIT II FRESH FRUITS AND VEGETABLES 8

Physical, Textural characteristics, structure and composition. Maturity standards; Importance, methods of Maturity determinations maturity indices for selected fruits and vegetables. Harvesting of important fruits and vegetables. Fruit ripening- chemical changes, regulations, methods. Storage practices: Control atmospheric, Bead atmosphere, hypotactic storage, cool store, Zero emerge cool chamber, stores striation. Commodity pre-treatment's - chemicals, wax coating, pre-packaging, phytonutrients in fruits and vegetables grading, cleaning, Physiological post harvest diseases chilling injury and disease. Handling and packaging of fruits and vegetables

UNIT III FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES 9

General pre processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance.

UNIT IV CANNING, PUREES AND JUICES 12

Canning- General pre processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/ pastes - General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance

UNIT V FRUIT AND VEGETABLE PRODUCTS**8**

Ready to eat fruit and vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic, Dried Onion, Powder. Garlic: Dried Garlic, Powder, Oil. Potato: Wafer; starch, Papad, Carrot: Preserve, candy, Pickle, Jam. Cauliflower and cabbage: Dried cauliflower and cabbage,

Sauerkraut, Pickle Leafy vegetables; Dried Leafy Vegetables. (Spinach, Fenugreek, Coriander leaves, Curry leaves). Bitter gourd: Pickle, Dried bitter gourd. Indian Food Regulation and Quality assurance

TOTAL: 45 PERIODS**OUTCOMES:**

On completion of the course the students are expected to

- Better understanding of the concepts of physiological characteristics of fruits and vegetables Better insight about fruit losses during storage and ways to prevent it.
- Thorough Knowledge and understandings of the specific processing technologies used for different foods and the various products derived from these materials.

TEXT BOOKS:

1. Fellows, P J. "Food Processing Technology: Principles and Practice". 2nd Edition, CRC/Woodhead, 1997.
2. Salunke, D. K and S. S Kadam "Hand Book of Fruit Science and Technology: Production, Composition, Storage and Processing". Marcel Dekker, 1995.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.

FD8611**FRUITS AND VEGETABLE
PROCESSING TECHNOLOGY LABORATORY****L T P C
0 0 4 2****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

EXPERIMENTS:

1. Preparation of orange squash and cordial.
2. Preparation of canned peas / pine apple.
3. Preservation and processing of certain vegetables by drying and dehydration
4. Preparation of Jam/Jelly and its preservation by sugar
5. Preparation of pickles
6. Osmotic concentration/dehydration of certain fruits and vegetables using
7. concentrated sugar and salts solutions
8. Preparation of malt based drink.
9. Preparation of fruit juice/pulp and its preservation by chemical Preservatives/ thermal processing.
10. Preparation of tomato puree/ketchup and its preservation by chemical preservatives
11. Experiment on preparation of fruit bar.
12. Experiment on preparation of Ready to serve beverages.

13. Experiment on quality evaluation of fruit beverages.
14. Experiment on fermented fruit and vegetable preparation.
15. Experiment on quality evaluation of fermented fruit and vegetable products.

TOTAL: 60 PERIODS

OUTCOME:

- On the completion of the course, the students will be able to get experience on fruit and vegetable process technology.

TEXT BOOKS:

1. B. Sivasankar. " Food Processing and Preservation". PHI Learning Private Limited. 2015.
2. Fellows, P.J. " Food Processing Technology: Principles and Practice". Woohed Pub.Ltd, 2nd Edition, 2002.

REFERENCES:

1. M. Shafeiur Rahman (1999). Handbook of Food Preservation, Marcel Dekker, Inc.
2. Khetarpaul N. " Food Processing and Preservation". Dya Publishing House , NewDelhi. 2005.

Equipment Needed for 30 Students

Mixer	1
Canning unit	1
Metal can sealer	1
Tray dryer	1
Refractometer	1
Jelly cups/moulds	10
Cooking vat	5
Gas stove	2
Gas cylinder	2
Stainer	5
Blender	2
Retort processor	1
Laminar air flow chamber	1
Incubator	1
Viscometer	1

FD8612

**BAKING AND CONFECTIONERY TECHNOLOGY
LABORATORY**

**L T P C
0 0 4 2**

OBJECTIVE:

- This course will enable the student to acquaint with the preparation of various bakery products and perform quality analysis for the same

EXPERIMENTS

1. Study of ingredients (major and minor): characteristics of flour, yeast, shortening, sugar, egg and salts.
2. Experiment on leavening action of baking powder, sodium- bicarbonate and ammonium-bi-carbonate.
3. Determination sedimentation value of flour
4. Estimation of water absorption power (atta, and maida)

5. Determination dough rising capacity of yeast
6. Studies of dough characteristics farinographic and extensographic
7. Preparation of biscuits-different types.
8. Preparation of bread-different types.
9. Preparation of toffees.
10. Preparation of sugar boiled confectionary.
11. Preparation of candy.
12. Visit to a bakery/confectionary industry.

TOTAL: 60 PERIODS

Equipment Needed for 30 Students

Refrigerator	2
Sedimentation cylinder	1
Deck oven	1
Dough mixer	3
Fermentation cabinet	1
Humidity chamber	1
Hunter calorimeter	1
Cake & candy moulds	10
Farinograph	1
Extensograph	1
Egg beater	3
Texture analyzer	1
Weighing balance	1
Utensils/Glassware	As required

REFERENCES / MANUALS/SOFTWARE:

- Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition. Blackie Academic and professional, Glasgow(1995).

FD8701

DAIRY PROCESS TECHNOLOGY

L T P C

3 0 0 3

OBJECTIVE:

- To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products, sanitation and effluent treatment in dairy industry

UNIT I PROPERTIES OF MILK

7

Milk-Types-Composition-Physical-Chemical and Thermal Properties-Heat Capacity, Density-Freezing-Boiling point-Expansion-Agitation-Viscosity-Classification of milk Market and Special Milk Handling-effects of Merits on Milk-toxicity of metals.

UNIT II PROCESSING AND QUALITY PARAMETERS OF MILK

10

Processing of Milk- Pasteurization-HTST, UHT, sterilization, Homogenization, Filtering and Clarification of Milk-cream separation-Methods and Equipment's-Emulsification – Fortification, packaging of milk and milk products, judging and grading of milk, national and international standards of milk and milk products.

UNIT III MILK PRODUCTS

12

Traditional dairy products, Manufacturing of Yogurt, Cheese, Butter, Ghee, Ice-cream, malted products, evaporated milk products - properties, Classification-processing Methods, Equipment used, standards and quality parameters.

UNIT IV MILK POWDER PROCESSING AND MILK SUBSTITUTES 9

Processing of Milk Powder- Composition - Properties- methods of drying, substitutes for milk and milk products – casein, lactose and other by-products, weaning foods, therapeutic foods, fortification and enrichment.

UNIT V STORAGE SANITATION AND EFFLUENT TREATMENT 7

Storage of Milk in Tanks-Storage of ice cream and other milk products - in cold storage - Cleaning and Sanitation-Importance-Detergents-Properties-Cleaning procedures-Cleaning in place-Dairy effluent treatment and disposal.

TOTAL: 45 PERIODS

OUTCOME:

- The students will gain knowledge about dairy processing and understand the manufacturing processes of various dairy products

TEXT BOOKS:

1. Ananthkrishnan, C.P., and Sinha, N.N., "Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1984.
2. Warner, J.N., "Principles of Dairy Processing", Wiley Eastern Pub. Co., New York, 1975.
3. Walstra, P., "Diary Technology: Principles of Milk Properties and Processes". Marcel Dekker, 1999
4. Spreer, Edgar "Milk and Dairy Product Technology". Marcel Dekker, 2005.

REFERENCES:

1. Tufail Ahmed., "Dairy Plant Engineering and Management", KitabMahal Publishers, Allahabad, 1997.
2. Lampert, Lincoln M. "Modern Dairy Products: Composition, Food Value, Processing, Chemistry, Bacteriology, Testing, Imitation Dairy Products". Chemical Publishing Company, 1998.
3. Selia, Jane dos Reis Coimbra and Jose A. Teixeir "Engineering Aspects of Milk and Dairy Products". Jane Selia dos Reis Coimbra & Jose A. Teixeir, CRC Press, 2009

**FD8702 FOOD SAFETY, QUALITY AND REGULATION L T P C
3 0 0 3**

OBJECTIVES:

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- 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

UNIT I 10

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 **8**

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 to monitor 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 PERIODS

OUTCOMES:

- Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
- 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, 2003

FD8703

FOOD PACKAGING TECHNOLOGY

L T P C

3 0 0 3

OBJECTIVE:

- The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used. This course will enable students to appreciate the application of scientific principles in the packaging of foods.

UNIT I **BASICS OF PACKAGING**

6

Packaging –Concepts, definition, Significance, classification. Packaging – Development, Retail/Unit; Packaging of foods –fresh and processed

UNIT II PACKAGING MEDIA & MATERIALS 12

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 12

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 7

Food marketing and role of packaging; Packaging aesthetic and graphic design; Packaging – Laws and regulations

UNIT V ENVIRONMENTAL ISSUES IN PACKAGING 8

Coding and marking including bar coding and Environmental, ecological & Economic issues, recycling and waste disposal.

TOTAL: 45 PERIODS

OUTCOMES:

To gain knowledge on

- The different types of materials and media used for packaging foods.
- Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved food safety, 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.

FD8711 TESTING OF PACKAGING MATERIALS L T P C
LABORATORY 0 0 4 2

OBJECTIVES:

To develop skills related to

- Testing methods for packaging materials to assure quality
- Use of various techniques to check the barrier properties of packaging materials to avoid contamination

EXPERIMENTS:

1. Testing of physical/mechanical properties of food packaging material .
2. Testing of thermal shock resistance of glass .

3. Gas/Vacuum packaging of foods and shelf life studies.
4. Determination of Water Vapor Transmission rate of Packaging Material.
5. Determination of grease resistance of papers used in food industry – butter paper & toffee wraps.
6. Determination of adhesive test of tapes
7. Determination of drop test using food packets
8. Estimation of water absorption test in paper based materials
9. Experiment on sealing of plastic cups
10. Experiment on retort packing
11. Edible packaging of Food Samples.
12. Study of Sorption Isotherm for Food Package Design.
13. Packaged food cut-out analysis.

. TOTAL: 60 PERIODS

Equipment Needed for 30 Students

Tensile testing machine digital	1
Wall thickness gauge	1
Friction tester	1
Puncture resistance tester	1
Modified Atmospheric cum Vacuum Packaging machine	1
Moisture meter	1
Drop tester	1
Pouches	1
Heat sealer	1
Freshness tester	1
Retort processor	1

OUTCOME:

- On the completion of the course, the students will be able to get experience on testing food packaging materials to assure quality of foods.

TEXT BOOKS:

1. Robertson, G.L. "Food Packaging: Principles and Practice (2nd Edn). Taylor & Francis. 2006.

REFERENCES:

1. Han, J.H. "Innovations in Food Packaging". Elsevier Academic Press, 2005.
2. Ahvenainen, R. "Novel Food Packaging Techniques". CRC Press. 2003.
3. Coles, R., McDowell, D. and Kirwan, M.J. "Food Packaging Technology". CRC Press. 2003.

FD8712

DAIRY PROCESS TECHNOLOGY LABORATORY

L T P C

0 0 4 2

OBJECTIVES:

To develop skills related to

- Preservation and analytical techniques in milk and milk products
- Use of various techniques and additives for milk product processing and quality analysis

EXPERIMENTS:

Properties of milk

1. Analysis of milk

2. Platform test - Methylene Blue Reduction Test, clot on boiling test
3. Determination of protein in milk by formol titration (pynes method)
4. Determination of lactose content of milk by polarimeter
5. Estimation of milk fat by Gerber method or Milko tester
6. Phosphatase test
7. Determination of adulterant and preservatives of milk
8. Efficiency of sterilization in preparation of sterilized milk by turbidity test.
9. Determination of redox potential, acidity and pH of milk
10. Determination of viscosity, density and specific gravity of milk

Milk products and Quality Analysis

11. Preparation and analysis of Yoghurt
12. Preparation and analysis of Cottage cheese
13. Preparation and analysis of Ice-cream/ Cream
14. Preparation and analysis of Butter/ Ghee

TOTAL: 60 PERIODS

Equipment Needed for 30 Students

Gerber centrifuge	1
Butyrometer	15
Lactometer	4
Water bath	4
Refractometer	3
Polarimeter	1
Milko tester	1
pH meter	3
Deep freezer	1
Heating mantle	5
Thermometer	3
Weighing balance	2
Kjeldhal apparatus	1
Lovi bond comparator disc	1
Laminar air flow chamber	1
Incubator	1
Blast freezer	1
Homogeniser	1
Utensils/Chemicals/Glassware As required	

OUTCOME:

- On the completion of the course, the students will able to get experience on dairy process technology.

REFERENCES:

1. Ralph Early, "Technology of Dairy Products" Springer Science & Business Media, 1998
2. Edgar R. Ling, "Textbook of Dairy Chemistry", Vol II, London, 1945

FD8001

BIOLOGY AND CHEMISTRY OF FOOD FLAVOURS

L T P C

3 0 0 3

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 PERIODS

OUTCOMES:

- Better understanding and knowledge of contribution of different compounds for the development of flavor and Analytical techniques involved in flavor analysis.

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.

FD8002	PULSE AND OIL SEED TECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVE:

- The course aims to develop the knowledge of students in the area of pulse and oil seed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

UNIT I INTRODUCTION 9

Present status and future prospectus of Pulse and Oil seeds, Morphology of legume. Classification and types of legumes and pulses. Chemical composition and nutritional value. Anti-nutritional factors, their chemistry, methods of removal of anti-nutritional factors.

UNIT II LEGUMES 9

Processing of legumes: Home scale, Cottage Scale and commercial methods of dehulling. Modern techniques in Dal mills. Processing of Red gram, Bengal gram, Green gram, Black gram. Dal milling – Principle, methods, equipments and effect on quality. Principle products, Dry and Wet milling of pulses, Fermented Products of legumes. Soaking – Principles, Methods of soaking - Sprouting, Puffing, Roasting & Parboiling of Legumes, Physical and Bio-chemical changes during these processes. Cooking quality of dhal – methods, factors affecting quality of dhal and cooking of dhal. Quick cooking dhal, Instant dhal.

UNIT III SOYA PROCESSING 9

Soya as a source of protein and oil; Processing of Soya - soya milk, soy protein Isolate, soya paneer, soya sauce; extrusion technology and production of textured vegetable proteins.

UNIT IV OIL SEEDS 9

Chemical composition and characters of oil seed and Oils, Anti-nutritional factors, elimination Methods. Post Harvest Technology of Oil seeds, Handling Drying, Storage, Grading, Pre treatments, cleaning, Dehulling, Size reduction and flaking. Oil extraction: Traditional Methods, Ghani, Power Ghans, Expellers - Principle of Expeller, structure design of expeller. Solvent extraction process: Principle, Pre treatment - Breaking, Cracking, flaking.

UNIT V OIL SEED PROCESSING 9

Extraction principles, factors affecting the extraction process. Desolventization. Refining of Oils - Degumming, neutralization, bleaching, filtration, deodorization, their Principles and process controls. New Technologies in oil seed processing, utilization of oil seed meals of different food uses. High protein Product, like protein concentrate and isolates.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for pulses and oil seeds and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

TEXT BOOKS:

1. Lawson, Harry "Food Oils and Fats: Technology, Utilization, and Nutrition". CBS Publishers, 1997.
2. Hamm, Wolf and Richard J Hamilton "Edible Oil Processing" Blackwell Publishing, 2004
3. Gunstone, Frank D. "The Chemistry of Oils and Fats: Sources, Composition, Properties and Uses" Blackwell Publishing, 2004.

REFERENCES:

1. Rajah, Kanesh K. "Fats in Food Technology", Blackwell / Ane Books, 2004.

2. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.

FD8003

TRADITIONAL FOODS

L T P C

3 0 0 3

OBJECTIVE:

- To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

UNIT I HISTORICAL AND CULTURAL PERSPECTIVES 9

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sun-drying, osmotic drying, brining, pickling and smoking.

UNIT III TRADITIONAL FOOD PATTERNS 9

Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

UNIT IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS 12

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V HEALTH ASPECTS OF TRADITIONAL FOODS 6

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments / illnesses.

TOTAL: 45 PERIODS

OUTCOMES:

- To understand the historical and traditional perspective of foods and food habits
- To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:

1. Sen, Colleen Taylor "Food Culture in India" Greenwood Press, 2005.

2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

GE8071

DISASTER MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

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 DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

FD8004 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To introduce process economics and industrial management principles to chemical engineers.

UNIT I PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION 15

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION 10

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT 8

Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 4

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL 8

Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer. Elements of quality control, role of control charts in production and quality control.

TOTAL: 45 PERIODS

OUTCOMES:

- The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

TEXT BOOKS:

1. Peters, M. S. and Timmerhaus, C. D., "Plant Design and Economics for Chemical Engineers", V Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., "Introduction to process Economics", IEdn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., "Production and Costing", Khanna Publishers, New Delhi, 1988.

REFERENCES:

1. Allen, L.A., "Management and Organization", McGraw Hill.
2. Perry, R. H. and Green, D., "Chemical Engineer's Handbook", VII Edn., McGraw Hill.

**FD8005 FUNCTIONAL FOODS AND NUTRACEUTICALS L T P C
3 0 0 3**

OBJECTIVES:

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease

UNIT I INTRODUCTION AND SIGNIFICANCE 6

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes

UNIT II ANALYSIS OF PHYTOCHEMICALS 12

Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 12

In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology;

UNIT II FOOD ALLERGY AND SENSITIVITY 9

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

UNIT III PRINCIPLES OF TOXICOLOGY 9

Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Biological factors that influence toxicity, toxin absorption in the G.I. track, Industrial microflora, blood, brain barrier, storage and excretion of toxins

UNIT IV DETERMINATION OF TOXICANTS IN FOOD SAMPLING 9

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.

UNIT V TOXICANTS FORMED DURING FOOD PROCESSING 9

Intentional direct additives, preservatives, nitrate, nitrite, and N-nitroso compound flavour enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials.

Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N-nitrosamines, Acrylamide and their mode of action

TOTAL: 45 PERIODS

OUTCOME:

- Awareness about the different types of allergens and Natural toxins associated with food

TEXT BOOKS:

1. Helferich, William and Carl K. Winter "Food Toxicology", CRC Press, 2001.
2. Alluwalla, Vikas "Food Hygiene and Toxicology" Paragon International Publishers, 2007
3. Shibamoto, Taka yuki and Leonard F. Bjeldanzes "Introduction to Food Toxicology" II Edition. Academic Press, 2009.
4. Maleki, Soheila J. A. Wesley Burks, and Ricki M. Helm "Food Allergy" ASM Press, 2006.

REFERENCES:

1. Labbe, Ronald G. and Santos Garcia "Guide to Food Borne Pathogens" John Wiley & Sons, 2001.
2. Cliver, Dean O. and Hans P. Riemann "Food Borne Diseases" II Edition., Academic Press/Elsevier, 2002.
3. Riemann, Hans P. and Dean O. Cliver "Food Borne Infections and Intoxications" III Edition., Academic Press/Elsevier, 2006.

**FD8007 SPICES AND PLANTATION TECHNOLOGY L T P C
3 0 0 3**

OBJECTIVES:

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

UNIT I IMPORTANCE AND PROCESSING OF SPICES 9

A. Major Spices

Post Harvest Technology, composition, processed products of - Pepper, Cardamom, onion, ginger and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavour identical - Quality control, Flavour of major spices - Spice oil and oleoresins.

B. Minor Spices

Post Harvest Technology, composition, processed products of - Cumin, Coriander, Cinnamon, fenugreek, pepper, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – flavours, Quality control, Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

UNIT II PROCESSING OF COFFEE AND TEA 12

A. Coffee - Occurrence – chemical constituents – harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting – Process flow sheet for the manufacture of coffee powder – Instant coffee, methods, process and equipment involved– Chicory chemistry - Quality grading of coffee

B. Tea - Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process and equipment involved – Green tea manufacture – Instant tea manufacture – Grading of tea, Processing and quality control.

UNIT III CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS 9

Occurrence - Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor manufacture Chocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates

UNIT IV PROCESSING OF COCONUT, OILPALM, ARECANUT AND CASHEW 9

Processing of plantation crops – production and importance – processing of coconut, oilpalm, arecanut, cashew– harvesting and stages of harvest – drying, cleaning and grading – production of value added products – packaging and storage of produces.

UNIT V PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES 6

Cleaning and grading of spices - packaging and storage of spices – grading specifications – Agmark, ASTA, ESA specifications - processes involved in the manufacture of oleoresins and essential oils – quality analysis of spices and their derivatives

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the subject, students will be able to understand the processing steps involved for different plantation products and spices.

TEXT BOOKS:

1. Pandey, P. H. 2002. Post Harvest Engineering of Horticultural Crops through Objectives. SarojPrakasam, Allahabad.

- Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest Technology. Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi. PP. 514.

REFERENCES

- ASTA, Official analytical methods of the American Spice Trade Association, IV Edition, 1997
- Purseglove, J.W., E.G.Brown, G.L.Green and S.R.J.Robbins. 1981.
- Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series, Longman, London, 1981
- Pruthi, J.S. Spices and Condiments: Chemistry, Microbiology and Technology. First Edition. Academic Press Inc., New York, USA. 1980..

GE8075

INTELLECTUAL PROPERTY RIGHTS

L T P C

3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION

9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs

10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS

10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW

9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs

7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL:45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS:

- Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
- S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

FD8008

FOOD PROCESS EQUIPMENT DESIGN

L T P C
3 0 0 3

OBJECTIVE:

- To understand the construction requirements, process design, fabrication and installation of equipments and to enhance the knowledge in the design of food processing equipments.

UNIT I INTRODUCTION 9

Material of construction: Introduction to material selection; Material properties; Environmental effects on material selection; Mechanical properties & strength of materials.

UNIT II CONSTRUCTION REQUIREMENTS 9

Design basis: Design code; Design pressure, stress & factor of safety; Corrosion allowance; Weld joint efficiency factor; Design loadings; Criteria of failure.

UNIT III DESIGN OF PIPES AND PRESSURE VESSELS 9

Design of pipe and pipe fittings. Process vessels under internal and external pressure; Design of attachments and closures;

UNIT IV DESIGN OF SUPPORTS 9

Design of flange connections & threaded fasteners; Design of supports; Bracket or Lug supports, Leg Supports, Skirt Supports

UNIT V DESIGN OF PROCESS EQUIPMENTS 9

Process Design of double pipe heat exchanger; Shell & Tube Heat Exchanger. Design of Evaporator; Agitation Vessels and centrifugal separator. Design of Rotary Dryer.

TOTAL: 45 PERIODS

OUTCOME:

- Ability to design, fabricate and operate processing equipments

TEXT BOOKS:

1. B.C. Bhattacharya.—Introduction to Chemical Equipment Design — Mechanical Aspects, CBS Publishers, Delhi, 1991.
2. Anantha krishnan. C.P. and M.N. Sinha.—Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1997.

REFERENCES

1. Groff, Gane K. and Muthu, John F.,—Operations Management Selected Readings, D.B. Taraporevala Sons and Co, Bombay, 1975.
2. Thuesen, H.G., Febrycky, W.J. and Thuesen, G.J.,—Engineering Economy, Prentice-Hall Inc, New Jersey, 1978.
3. Stoner, A.F. James.—Management, Prentice-Hall of India, New Delhi, 1994.

FD8009

CEREAL TECHNOLOGY

L T P C

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of Cereal processing and technology.
- This is necessary for effective understanding specific aspects of food processing related to these foods.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials.

UNIT I PRODUCTION, STRUCTURE AND COMPOSITION 6

Status, major growing areas and production of cereals and millets in India and the world, structure, Physical properties; Density, Bulk density, Angle of repose, Hardness, asperity, porosity, stack of milling and moisture on physical properties. Chemical composition, Distribution of nutrients and Aroma of cereals and millets; anti-nutritional factors.

UNIT II WHEAT AND RICE 15

Wheat: Morphology, Physicochemical properties, Wheat Quality, Wheat Milling, quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Milling of rice: Conventional Milling, Modern milling, Advantages and disadvantages of milling machineries, By products of rice milling, Parboiling of rice: Aging of rice: Enrichment: - Need of Enrichment, Methods of enrichment, Enrichment levels, fortification of amino acids. -Processed Foods from rice: Breakfast cereals, flakes, puffing, canning and instant rice.

UNIT III OTHER CEREALS 9

Corn - Morphology, Physico-chemical properties, Corn milling - Wet and dry milling, Milling fractions and modify starches Corn Products – Corn flakes, Corn starch, canned corn products, puffed product; HFCS; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Rye bread; Traditional and Fermented cereal products

UNIT IV MILLETS 6

Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - storage, insect control; processing - Pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT V BAKED AND EXTRUDED PRODUCTS 6

Baked foods - chemical dough development, mechanical dough development, sheeting extrusion other rapid methods; Bread staling – theory, manifestation, retardation measures; Indian Confectionery. Extrusion processing – methods and products.

TOTAL: 45 PERIODS**OUTCOMES:**

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for cereals
- Understand the application of scientific principles in the processing technologies specific to the materials.

TEXT BOOKS:

1. Matz, Samuel A. " The Chemistry and Technology of Cereals as Food and Feed" II Edition, CBS, 1996.

2. Delcour, Jan A. and R. Carl Hosney. "Principles of Cereal Science and Technology". III Edition. American Association of Cereal Chemists, 2010.
3. Kulp, Karel "Handbook of Cereal Science and Technology". II Edition, CRC Press, 2000.
4. Morris, Peter C. and James H Bryce "Cereal Biotechnology". CRC / Woodhead, 2000

GE8076

PROFESSIONAL ETHICS IN ENGINEERING

L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES

10

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

8

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 PERIODS

OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of

India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. 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.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

BT8091 INSTRUMENTATION AND PROCESS CONTROL L T P C
3 0 0 3

AIM :

- To familiarize the students with concepts of process dynamics and control leading to control system design.

OBJECTIVE:

- To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

UNIT I INSTRUMENTATION 9

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 9

Laplace transformation, application to solve ODEs. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 9

Closed loop control systems, development of block diagram for feed-back control systems servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV FREQUENCY RESPONSE 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

12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, 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

7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: 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 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and 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. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

FD8011

FOOD PLANT DESIGN

L T P C

3 0 0 3

OBJECTIVE:

- To enable the students understand the various concepts of process development, design consideration and cost estimation in food industry.

UNIT I OVERALL DESIGN OF AN ENTERPRISE

9

Plant design, sales planning for plant design. Plant Location, levels of Plant location. Location of layout: location factors, plant site selection. Location theory and models, industrial buildings and

grounds. Classification of Dairy and Food Plants, farm level collection and Chilling center. Space requirement.

UNIT II PREPARATION OF A PLANT LAYOUT 9

Plant Layout problem, importance, objectives, classical types of layouts. Evaluation of Plant Layout. Advantages of good layout. Organizing for Plant Layout, Data forms.

UNIT III DEVELOPMENT AND PRESENTATION OF LAYOUT 9

Development of the pilot layout, constructing the detailed layout: Functional design: Sitting of different sections in a plant, Layout installations.

UNIT IV QUANTITATIVE ANALYSIS FOR PLANT LAYOUT 9

Engineering economy. Linear programming. Queing theory. Common Problems in Plant Layout and Process scheduling. Siting of Process sections, Equipment selection and capacity determination, Arrangement of process, and service equipment. Estimation of Services and Utilities. Office layout, line balancing, Flexibility.

UNIT V PRACTICAL LAYOUTS 9

PRACTICAL LAYOUTS: Common materials of construction of Food plant, building. Maintenance of Food Plant Building, Illumination and ventilation, Cleaning & sanitization, painting and colour coding, Fly and insect control.

TOTAL: 45 PERIODS

OUTCOME:

- The students will be able to apply their knowledge to design projects for setting up a Food Processing Industry.

TEXT BOOKS:

1. M Moore, Mac Millan, "Plant Layout & Design". Lames, New York, 1971.
2. H.S. Hall & Y.S. Rosen, "Milk Plant Layou". FAO Publication, Rome, 1963.
3. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas, "Food Plant Design (Food Science and Technology)", CRC Press, 2005.

REFERENCE:

1. "Food plant engineering system" by Theunis C. Robberts, II Edition, CRC Press, Washington, 2013
2. "Food plant economic" by Zacharias B. Maroulis and George D. Saravacos published by Taylor and Francis Group, LLC, 2008
3. John Holah, HuubLelieveld, "Hygienic Design of Food Factories", Woodhead Publishing, 2011.
4. Slade, S. "Food Processing Plant" Vol. 1, Leonard Hill Books, 1990

FD8012

SPECIALITY FOODS

L T P C

3 0 0 3

OBJECTIVE:

- 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 **12**
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 nutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods.

C. 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 **6**
Specific consumer oriented foods; Defence persons, Space / astronaut, High altitude mountain climbers, Disaster situation – crises, care, maintenance.

TOTAL: 45 PERIODS

OUTCOME:

The students will be able to
Understand the benefits of various speciality 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

FD8013 **ENTREPRENEURSHIP** **L T P C**
3 0 0 3

UNIT I **9**

- Should You Become an Entrepreneur?
- What Skills Do Entrepreneurs Need?
- Identify and Meet a Market Need
- Entrepreneurs in a Market Economy
- Select a Type of Ownership

UNIT II **9**

- Develop a Business Plan

UNIT III **9**
 • Choose Your Location and Set Up for Business
 • Market Your Business
 • Hire and Manage a Staff

UNIT IV **9**
 • Finance, Protect and Insure Your Business
 • Record Keeping and Accounting
 • Financial Management

UNIT V **9**
 • Meet Your Legal, Ethical, Social Obligations
 • Growth in Today's Marketplace

TOTAL: 45 PERIODS

TEXT BOOK

1. Entrepreneurship Ideas in Action—South-Western, 2000.

FD8014	BEVERAGE TECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVE:

- The course aims to gain knowledge on machinery and process involved in beverage technology and fermentation process involved in making beverage process

UNIT I BASIC INGREDIENTS IN BEVERAGES **9**
 Beverage-definition-why we drink beverages-ingredients- water, carbon dioxide, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, colours – natural and artificial, Micro and nanoemulsions of flavors and colors in beverages, preservatives, emulsifiers and stabilizers.

UNIT II BEER AND WINE MANUFACTURE **9**
 Ingredients- Malt- hops- adjuncts- water, yeast. Beer manufacturing process, distillation, malting, preparation of sweet wort, brewing, fermentation, pasteurization and packaging. Beer defects and Spoilage.Wine-fermentation-types –red and white. Wine defects and spoilage

UNIT III CARBONATED BEVERAGES **9**
 Procedures- carbonation equipments-ingredients-preparation of syrups-Filling system-packaging- containers and closures

UNIT IV NON CARBONATED BEVERAGE **9**
 Coffee bean preparation-processing-brewing-decaffeination- instant coffee-Teatypes- black, green and oolong- fruit juices, nectars, quash, RTS beverages, isotonic Beverages. Flash pasteurization, Canning and Aseptic Packaging of beverages

UNIT V QUALITY CONTROL **9**
 Effective application of quality controls, brix, acidity to brix ratio, single strength of juice- sanitation and hygiene in beverage industry-Quality of water used in beverages - threshold limits of various

ingredients according to PFA, EFSA and FDA – Absolute requirements of Soluble solids and titrable acidity in beverages.

OUTCOMES:

On completion of the course the students are expected to

- Be able to understand various concepts, principles and procedures involved in processing of beverages.
- Demonstrate various unit operations involved in the food beverage manufacturing.
- List the quality control steps in beverage preparation.

TEXT BOOKS:

1. Ashurst, P.R, "Chemistry and technology of Soft drink and fruit juices", 2nd edition, Blackwell Publishing Ltd. 2005.
2. Steen, D.P and Ashurst, P.R, "Carbonated soft drinks – Formulation and manufacture", Blackwell Publishing Ltd. 2000.
3. Shankunthala Manay, N. and Shadakdharaswamy, M, "Foods – Facts and Principles", New Age International Pvt. Ltd, 3rd revised edition 2000.
4. Charles, W.Bamforth, "Food, fermentation and microorganisms", Blackwell Science Publishing Ltd. 2005.

REFERENCES:

1. Amalendu Chakraverty et al, "Handbook of Post Harvest Technology", Ed.:, Marcel Dekker Inc. (Special Indian edition) 2000.
2. Robert.W.Hutkins, "Microbiology and Technology of Fermented foods", IFT Press, Blackwell Publishing Ltd. 2006.
3. "Brewing yeast and fermentation Chris Boulton and David Quain", Blackwell Science Ltd
4. "Prevention of Food Adulteration Acts and Rules Manual"

FD8015

POST HARVEST TECHNOLOGY

L T P C
3 0 0 3

AIM:

The course aims to develop the knowledge of students in the area of post harvest processing of various foods and related technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

OBJECTIVES:

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for different foods and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.

UNIT I CEREALS AND PULSES

9

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat - milling, (Atta and maida), quality aspects of flour, wheat proteins and their function; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, malting and malt products; Rice- Milling, Parboiling, Quick cooking rice. Pulses - Basic agricultural aspects,

structure, composition, storage, insect control, processingMilling/splitting, dhal milling, products– puffed, flakes, flour, soya milk, soy protein Isolate.

UNIT II VEGETABLES AND FRUITS 9

Climatic and non climatic fruits, ripening process, phytonutrients in fruits and vegetables; Handling, transportation, controlled atmosphere ripening process, grading, cleaning, pre treatments, modified atmosphere packaging, chilling. General pre-processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration– General pre processing, different methods of drying, osmotic dehydration and other modern methods. Canning - General pre-processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates Vegetable Purees/pastes.

UNIT III OIL SEEDS, NUTS AND SUGARS 9

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, hydrogenation; oil blends. Honey- Composition and Quality aspects; Sugars- Manufacture of table sugar, High Fructose corn syrup and Glucose syrup; Jaggery – sources, manufacture.

UNIT IV MILK AND MILK PRODUCTS 9

Processing of Milk – Pasteurisation, homogenisation, sterilization, HTST and UHT processes; Processing and preservation of milk products - cream, sour cream, butter, ghee, skimmed 94 milk concentrate and skimmed milk powder, whey concentrate and whey powder, yoghurt, cheese and other products.

UNIT V MEAT, FISH & POULTRY 9

Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant. Structure and composition of meat, carcass chilling, ageing; storage of fresh meat - Modified atmosphere packaging, packaging of retail cuts; Processing and preservation - artificial tenderizing, chilling, freezing, curing, smoking, ready-to-eat meats and meat products; Kosher and Halal certification. Marine and fresh water fish, shell fish - composition and nutrition; commercially important fish and shell fish; spoilage factors, ship board operations, storage and transport. Processing and Preservation - chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils. Types of poultry, production, classification & designation, grading. Processing plant operations - slaughter, bleeding, scalding, de-feathering, eviscerating, chilling, packaging; composition and nutrition, poultry meat products Eggs- structure, composition, quality factors, storage, pasteurization, freezing and drying, egg substitutes.

TOTAL: 45 PERIODS

OUTCOMES:

- Better understanding of the concepts of physiological characteristics of fruits and vegetables
- Better insight about fruit losses during storage and ways to prevent it.
- Thorough Knowledge and understandings of the specific processing technologies used for different foods and the various products derived from these materials.
- Understandings of the application of scientific principles in the processing technologies specific to the materials.

TEXT BOOKS:

1. Hamm, Wolf and Hamilton, R, J. “Edible Oil Processing”, Blackwell / Ane Books, 2004.

2. Morris, Peter C and Bryce, J.H. "Cereal Biotechnology", CRC / Wood Head, 2000.
3. Arthey, David and Ashwat P.R. "Fruit Processing: Nutrition, Products, and Quality Management", II Edition, Springer, 2005.
4. Eckles, C.H., W.B. Combs and H. Macy "Milk and Milk Products", IV Edition, Tata McGraw-Hill, 1973.
5. Singh, I.S. "Post-Harvest Handling and Processing of Fruits and Vegetables" Westville Publishing, 2009.
6. Srivastava, A.P. et al., "Mechanisation of Vegetable Production and Post-Harvest Management". Westville Publishing, 2009.

REFERENCES:

1. Rajah, Kanes K. "Fats in Food Technology", Blackwell / Ane Books, 2004.
2. Valpuesta, Victoriano "Fruit and Vegetable Biotechnology" CRC / Wood Head Publishing, 2002.
3. Mujumdar, A.S. "Dehydration of Products of Biological Origin", Oxford IBH, 2004.
4. Alzamora, S.M., Tapia, M.S. and Lopez – Malo, A. "Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications", Springer, 2005.
5. Salunkhe, D.K. and Kadam, S.S. "Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing", Marcel Dekker, 2005.
6. "Agro – Food Processing: Technology Vision 2020 Fruits & Vegetables Current Status and Vision", TIFAC, 1996.
7. Sofos, J.N. "Improving and Safety of Fresh Meat" Wood Head Publishing / CRC, 2005

FD8016	MILLINGTECHNOLOGY	L T P C
		3 0 0 3
UNIT I	GRAIN PROPERTIES	9
<p>Importance of grains and cereals- definitions, Grain structure, Physico-chemical properties of grains and its nutritional value. Storage of cereal grains in relation to maintaining grain quality–types of storage structures.</p>		
UNIT II	MILLING OF RICE	9
<p>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 ricemilling and waste utilization.</p>		
UNIT III	MILLING PROCESS OF WHEAT	9
<p>Wheat milling flowsheet. Explanation of steps in milling, Cleaning Principles of Parboiling of wheat - Methods of Parboiling, Sifters, De-stoners, Roller-milling-Breakrolls, and reduction rolls, Sifting and purifying, plansifters. Bran separation. Efficiency of milling process. By products from wheat milling and waste utilization.</p>		
<p>Milling of Corn: Corn–types. Dry and wet milling of corn–flow sheet and explanation, By products from corn milling, cornstarch, cornsyrup, cornflakes. Waste utilization.</p>		

UNITIV 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.

UNITV 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.

TEXT BOOKS:

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

REFERENCES:

1. Kulp, K. and Pont, J.G.—Handbook of Cereal Science and Technology, Second Edition, Chapman & Hall, 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.

FD8017 CREATIVITY, INNOVATION AND NEW FOOD PRODUCT DEVELOPMENT L T P C 3 0 0 3

OBJECTIVE:

- 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 PERIODS

OUTCOME:

- To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

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.

BT8751

DOWNSTREAM PROCESSING

**L T P C
3 0 0 3**

OBJECTIVES:

To enable the students to

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Have depth knowledge and hands on experience with on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion

UNIT I INTRODUCTION

9

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products.

UNIT II PHYSICAL METHODS OF SEPARATION

9

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS

9

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION

9

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

9

Crystallization, drying and lyophilization in final product formulation.

TOTAL: 45 PERIODS

OUTCOMES:

Upon success completion of this course, the students will be able to:

- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu "Bioseparations – Downstream Processing for Biotechnology", John Wiley, 1988.
2. Sivasankar, B. "Bioseparations: Principles and Techniques". PHI, 2005.
3. Asenjo, Juan A. "Separation Processes in Biotechnology". CRC / Taylor & Francis, 1990.

REFERENCES:

1. Ghosh, Raja "Principles of Bioseparations Engineering". World Scientific, 2006
2. "Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

GE8074**HUMAN RIGHTS****L T P C****3 0 0 3****OBJECTIVE:**

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I**9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II**9**

Evolution of the concept of Human Rights Magna carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III**9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV**9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V**9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL: 45 PERIODS**OUTCOME:**

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - **Introduction to Product Development Methodologies and Management** - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling** - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design** - Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping** - Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair – Enhancements - **Product EoL** - Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

FD8018

MANAGEMENT OF FOOD WASTE

L T P C

3 0 0 3

OBJECTIVES:

- Importance of treating waste product from food industry.
- Treatment methods and recycling of waste product from food industry.

UNIT I CLASSIFICATION & CHARACTERIZATION OF FOOD INDUSTRY WASTE 8

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 FOOD INDUSTRY 10

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 V REGULATORY ISSUES WITH FOOD INDUSTRY WASTE 9

International and national scenario on disposal of waste from food industries; Regulatory issues with food industry waste

TOTAL: 45 PERIODS

OUTCOMES:

- Awareness of Importance in treating waste product from food industry.
- Knowledge of Treatment methods and recycling of waste product from food industry

TEXT BOOKS:

1. Herzka, A. and Booth, R.G. "Food Industry and Trade: Recycling Waste". Applied Science Publishers, 1981.
2. Tegge, G., Green, J. H., and A. Kramer. "Food Processing Waste Management"; AVI Publishing, 1979 .

REFERENCES:

1. VassoOreopoulou and Winfried Russ. "Utilization of by-products and Treatment of Waste in the Food Industry". Springer, 2007.
2. Ioannis S. Arvanitoyannis. "Waste Management for the Food Industries". Academic Press, 2008.

FD8019**FOOD SAFETY MANAGEMENT SYSTEMS****L T P C
3 0 0 3****OBJECTIVE:**

To enable the students to

- To understand the rules and regulations given by different food authority around the world to maintain food quality and safety.

UNIT I**10**

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**8**

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 to monitor 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 Committee setc.

TOTAL:45PERIODS**OUTCOMES:**

On Completion of this course students are expected to know the
Importance of food quality and safety
Rules and regulations related for processing foods

TEXT BOOKS:

1. Handbook of food toxicology by S.S.Deshpande
2. The food safety information handbook by Cynthia A.Robert,2009
3. Nutritional and safety aspects of food processing by Tannenbaum SR

REFERENCES:

1. Microbiological safety of food by HobbsBC,1973
2. Food Safety Handbook by Ronald H.Schmidt, Gary E.Rodrick

FD8020**GENETIC ENGINEERING AND GENETICALLY MODIFIED FOODS****L T P C****3 0 0 3****OBJECTIVES:**

Introduction to GM foods and their methods of production, advantages

- To study genetically modified plants which are commercially available
- To study transgenic animals and their engineering method
- To understand genetically modified microorganisms and their applications in foods
- To know about Pharmaceutical applications of genetically engineered plants
- To understand Risk and safety assessment of the GM foods and their labeling

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY**9**

Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES**9**

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA**9**

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT IV TRANSGENIC TECHNOLOGY**9**

DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid.

UNIT V APPLICATIONS OF RDNA TECHNOLOGY IN FOODS (Remove company names)

9

Genetically engineered proteins: Bovine Somatotropin in Milk; Genetically engineered bacteria: ChymosinLite beer; Tryptophan; Transgenic plants: Calgene Flavr Savr TM tomato, Monsanto Round-Up TM Ready, Ciba GeigyBasta TM resistant crops; Edible vaccines: Cholera vaccine in potatoes; Transgenic Fish: Atlantic salmon.

TOTAL: 45 PERIODS

OUTCOMES:

- Better understanding of genetically modified plants, animals and modified microorganisms
- Familiarize in Pharmaceutical applications of genetically engineered plants
- Obtain knowledge in Risk and safety assessment of the GM foods and their label

TEXT BOOKS:

1. Rees, Andy “Genetically Modifies Food: A Short Guide for the Confused”. Pluto Press, 2006.
2. Ahmed, Farid E. “Testing of Genetically Modified Organisms in Food”. Food Products Press, 2004.

REFERENCE:

1. Halford, Nigel G. “Genetically Modified Crops”. Imperial College Press, 2003.

FD8021

STORAGE ENGINEERING

**L T P C
3 0 0 3**

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of Food storage
- This is necessary for effective understanding specific aspects of food storage

UNIT I COLD STORAGE

9

Cold storage- Moist air and applied psychrometry, Estimation of cooling load, Air conditioning systems, Evaporators, Compressors, Condensers, Expansion devices, Cooling towers, Different types of refrigerants, Transmission and distribution system of cool air, Thermal and vapor insulation materials, Design of small capacity cold storage, Instrumentation and climate management in cold storage

UNIT II FROZEN STORAGE

9

Quality loses in frozen foods- Physical changes, Chemical changes in food components, Nutritional aspects of freezing, Microbiology of frozen products, Glass transitions temperature and stability of frozen foods, Temperature requirements during frozen storage, Shelf-life of frozen foods- shelf-life testing, Modelling loss of quality in frozen foods, Time-Temperature integrators, Packaging of frozen foods, Different types of freezers.

UNIT III CONTROLLED ATMOSPHERIC STORAGE

9

Biochemical considerations of CAS, Gas exchange mechanisms, Mass balance principles, Gas generators, Equipment’s for producing and regulating controlled atmosphere, Design of controlled atmosphere storage chambers.

UNIT IV MODIFIED ATMOSPHERIC STORAGE 9

Overview of Modified atmospheric storage, Gases and Vapor applied to modified atmosphere processing operations, MAP modelling- Kinetics of food deteriorative reactions, Shelf-life testing, Enzyme kinetics applied to MAP, MAP design with oxygen modelling

UNIT V HYPOBARIC STORAGE 9

History of Hypobaric storage, Experimental errors in hypobaric storage research, Gas and vapor mass transfer at low pressure, Requirements for installation- measurement devices (Relative humidity, Pressure, Air-change rate, Oxygen, Carbon dioxide, Ethyl alcohol, Acetaldehyde, hypobaric acid vapor), Flow control, Humidity control, Effects on food, Effects on microbes.

OUTCOMES:

- On completion of the course the students are expected to Understand the application of scientific principles in the processing technologies specific to the materials.

TEXT BOOKS:

1. "Hypobaric storage in food industry- Advances in technology and theory"- Stanley.P.Berg
2. "Frozen food science and Technology"- Judith.A.Evans
3. "Engineering for storage of fruits and vegetables"- Chandra Gopala Rao

FD8022	TECHNOLOGY OF FAT AND OIL	L T P C
		3 0 0 3

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of Fat and Oil processing and technology.
- This is necessary for effective understanding specific aspects of food processing related to these foods.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials.

UNIT I RAW MATERIALS AND PROPERTIES 11

Overview of fats and oil, sources of fats and oils- vegetables, animal fat; properties of fats and oils – nomenclature and structure; chemical properties and reactions – hydrolysis and free fatty acids, esterification, inter-esterification, saponification and iodine value, oxidative stability, peroxide value, conjugated dienes, anisidine value; physical properties – colour, crystal structure of fat, thermal properties, density, SFI, optical and spectroscopical properties.

UNIT II FAT AND OIL PROCESSING 8

Recovery of fats and oils from plant and animal sources, refining, bleaching hydrogenation, fractionation, process and product of inter-esterification deodorization.

UNIT III QUALITY OF FATS AND OILS 9

Flavour quality of fats and oils – formation of flavours and off-flavours, hydrolytic rancidity, oxidative rancidity, flavour impact of oxidation compound, factors affecting flavour quality – intrinsic and extrinsic, methods to measure flavour quality - chemical, sensory analysis, oil quality improvement through processing

UNIT IV OILS AND FATS APPLICATIONS 6

Utilization of fats and oils: shortening technology, margarine types and preparation technology, liquid oil technology, speciality fats and oils, by product utilization.

UNIT V NOVEL DEVELOPMENT IN FATS AND OIL TECHNOLOGY 12

Strategies for replacement of fats in food products – lipid based fat replacement – sucrose polyesters, propoxylated derivatives of glycerides, wax esters, esters of polycarboxylic acids, glyceryl fatty esters, partially digestible fat substitutes, protein based fat replacement, role of carbohydrate in replacement of fat, genically engineered and identity preserved oils

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for Fats and oils
- Understand the application of scientific principles in the processing technologies specific to the materials.

TEXT BOOK:

1. Introduction to oils and fats – “ Richard D.O'Brien” and “Watter. E. .farr”,;Peter. J.Wan”. Seconf edition.

**FD8023 EMERGING TECHNOLOGIES IN FOOD PROCESSING L T P C
3 0 0 3**

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of emerging or alternative technologies applied to food processing.
- This course will enable students to understand the advantages and disadvantages over existing technologies.

UNIT I HIGH PRESSURE PROCESSING OF FOODS 9

Introduction, principles, use of high pressure to improve food safety and stability. Effectsof 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 foodsand 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 fluidextraction – 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 PERIODS**OUTCOMES:**

On completion of the course the students are expected to

- Be able to understand and identify the different processing technologies and their application.
- Understand the application of scientific principles in the processing technologies specific to the materials.

TEXT BOOKS:

1. Da-Wen Sun, "Emerging Technologies for Food Processing", Academic press/ Elsevier, 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.

GE8077**TOTAL QUALITY MANAGEMENT****L T P C
3 0 0 3****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—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfield, 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 of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards