B.Tech. (Food Technology)
2015 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University, Chennai
Approved by AICTE - Accredited by NBA New Delhi, NAAC with 'A' Grade and ISO 9001:2008 Certified)
SATHYAMANGALAM – 638 401 Erode District Tamil Nadu
Phone : 04295 226000 Fax : 04295 226666
Web:www.bitsathy.ac.in E-mail : stayahead@bitsathy.ac.in

CONTENTS

B.TECH. (FOOD TECHNOLOGY)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- Acquire theoretical and practical knowledge of food processing and technology to become a qualified food engineer.
- Apply skills of food technology and allied disciplines in research, industry and entrepreneurship to ensure food and nutrition security.
- Serve the society by offering convenience and joy through food products with professional ethics.

PROGRAMME OUTCOMES (POs)

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

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

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

d. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. **Modern Tool Usage**: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

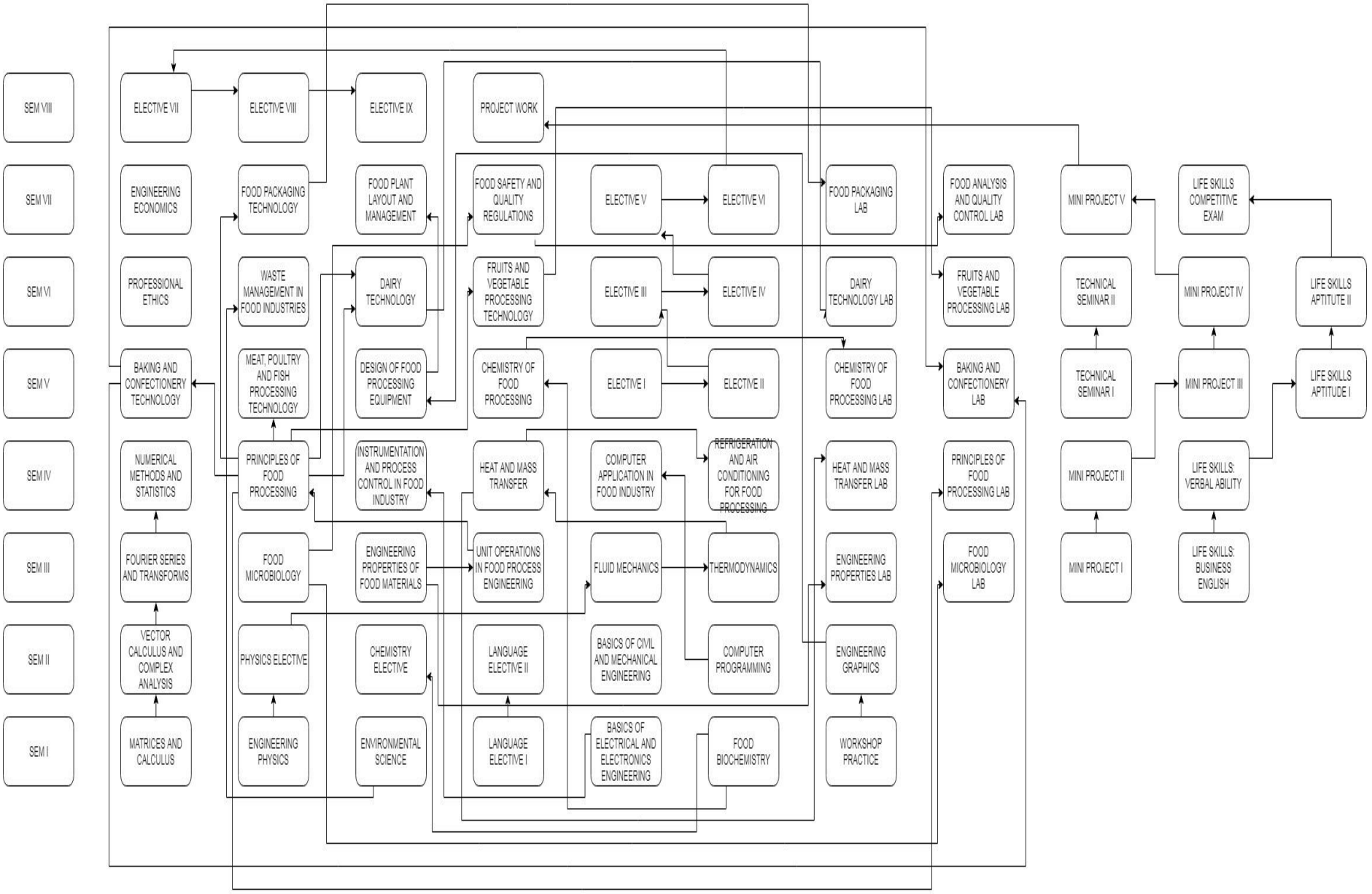
k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these

to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

MAPPING WITH PEOs AND POs

POs	a	b	c	d	E	F	g	h	i	j	k	l
PEO I	X	X	X	X							X	
PEO II		X		X	X		X	X				X
PEO III						X	X	X	X	X		


SEM VIII
SEM VII
SEM VI
SEM V
SEM IV
SEM III
SEM II
SEM I
ELECTIVE VII
ELECTIVE VIII
ELECTIVE IX
PROJECT WORK
ENGINEERING ECONOMICS
FOOD PACKAGING TECHNOLOGY
FOOD PLANT LAYOUT AND MANAGEMENT
FOOD SAFETY AND QUALITY REGULATIONS
ELECTIVE V
ELECTIVE VI
FOOD PACKAGING LAB
FOOD ANALYSIS AND QUALITY CONTROL LAB
MINI PROJECT V
LIFE SKILLS COMPETITIVE EXAM
PROFESSIONAL ETHICS
WASTE MANAGEMENT IN FOOD INDUSTRIES
DAIRY TECHNOLOGY
FRUITS AND VEGETABLE PROCESSING TECHNOLOGY
ELECTIVE III
ELECTIVE IV
DAIRY TECHNOLOGY LAB
FRUITS AND VEGETABLE PROCESSING LAB
TECHNICAL SEMINAR II
MINI PROJECT IV
LIFE SKILLS APTITUTE II
BAKING AND CONFECTIONERY TECHNOLOGY
MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY
DESIGN OF FOOD PROCESSING EQUIPMENT
CHEMISTRY OF FOOD PROCESSING
ELECTIVE I
ELECTIVE II
CHEMISTRY OF FOOD PROCESSING LAB
BAKING AND CONFECTIONERY LAB
TECHNICAL SEMINAR I
MINI PROJECT III
LIFE SKILLS APTITUDE I
NUMERICAL METHODS AND STATISTICS
PRINCIPLES OF FOOD PROCESSING
INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY
HEAT AND MASS TRANSFER
COMPUTER APPLICATION IN FOOD INDUSTRY
REFRIGERATION AND AIR CONDITIONING FOR FOOD PROCESSING
HEAT AND MASS TRANSFER LAB
PRINCIPLES OF FOOD PROCESSING LAB
MINI PROJECT II
LIFE SKILLS: VERBAL ABILITY
FOURIER SERIES AND TRANSFORMS
FOOD MICROBIOLOGY
ENGINEERING PROPERTIES OF FOOD MATERIALS
UNIT OPERATIONS IN FOOD PROCESS ENGINEERING
FLUID MECHANICS
THERMODYNAMICS
ENGINEERING PROPERTIES LAB
FOOD MICROBIOLOGY LAB
MINI PROJECT I
LIFE SKILLS: BUSINESS ENGLISH
VECTOR CALCULUS AND COMPLEX ANALYSIS
PHYSICS ELECTIVE
CHEMISTRY ELECTIVE
LANGUAGE ELECTIVE II
BASICS OF CIVIL AND MECHANICAL ENGINEERING
COMPUTER PROGRAMMING
ENGINEERING GRAPHICS
MATRICES AND CALCULUS
ENGINEERING PHYSICS
ENVIRONMENTAL SCIENCE
LANGUAGE ELECTIVE I
BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
FOOD BIOCHEMISTRY
WORKSHOP PRACTICE

B.TECH. FOOD TECHNOLOGY Minimum Credits to be Earned :175											
FIRST SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**POs**					**CA**	**ES**	**Total**	
15MA101	MATRICES AND CALCULUS*	I,II	a,b	3	2	0	4	50	50	100	BS
15PH102	ENGINEERING PHYSICS*	I,II	a	2	0	2	3	50	50	100	BS
15CH103	ENVIRONMENTAL SCIENCE*	I	g	2	0	2	3	50	50	100	HSS
	LANGUAGE ELECTIVE I#	II	-	3	0	0	3	100	-	100	HSS
15GE105	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERINGΔ	I	a	2	0	2	3	50	50	100	ES
16FD106	FOOD BIOCHEMISTRY	I, II	a,b,e,g	3	0	0	3	50	50	100	PC
15GE107	WORKSHOP PRACTICEΩ	I	a	0	0	2	1	50	50	100	ES
Total				**15**	**2**	**8**	**20**	**400**	**300**	**700**	**-**
SECOND SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**POs**					**CA**	**ES**	**Total**	
15MA201	VECTOR CALCULUS AND COMPLEX ANALYSIS*	I,II	a	3	2	0	4	50	50	100	BS
15PH202	PHYSICS ELECTIVE*	I	a	3	0	2	4	50	50	100	BS
15CH202	CHEMISTRY ELECTIVE*	I	a	3	0	2	4	50	50	100	BS
	LANGUAGE ELECTIVE II#	II	d, e	3	0	0	3	100	-	100	HSS
15GE205	BASICS OF CIVIL AND MECHANICAL ENGINEERINGξ	I	a	3	0	0	3	50	50	100	ES
15GE206	COMPUTER PROGRAMMINGΨ	I	a	3	0	2	4	50	50	100	ES
15GE207	ENGINEERING GRAPHICS◊	I	a	0	0	4	2	50	50	100	ES
Total				**18**	**2**	**10**	**24**	**400**	**300**	**700**	**-**

* Common to all branches of B.E./B.Tech

Common to all branches of B.E./B.Tech (Continuous Assessment)

Δ Common to AE,AG,AU,CE,ME,MTRS,BT,TT,FD (I Semester) and to CSE,FT,IT (II Semester)

Ω Common to AE,AG,AU,ME,MTRS,BT,FT,TT,FD (I Semester) and to CE,CSE,ECE,EEE,EIE,IT (II Semester)

ξ Common to CSE,ECE,EEE,EIE,FT,IT (I Semester) and to MTRS, BT,TT,FD (II Semester)

Ψ Common to CE (I Semester) and to AE,AG,AU,ME,MTRS,BT,FT,TT,FD (II Semester)

◊ Common to CE,CSE,ECE,EEE,EIE,IT (I Semester) and to AE,AG,AU,ME,MTRS,BT,FT,FD,TT (II Semester)

THIRD SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**Pos**					**CA**	**ES**	**Total**	
15MA301	FOURIER SERIES AND TRANSFORMS$^{\alpha}$	I	a,b	3	2	0	4	50	50	100	BS
16FD302	FOOD MICROBIOLOGY	I, III	a, d, f, g,l	3	0	0	3	50	50	100	PC
16FD303	ENGINEERING PROPERTIES OF FOOD MATERIALS	I,II	a,b,c,e	3	0	0	3	50	50	100	PC
16FD304	UNIT OPERATIONS IN FOOD PROCESSING	I,II,III	a,b,c,d	3	0	2	4	50	50	100	PC
16FD305	FLUID MECHANICS	I,II	a,b,c,d,e	3	2	0	4	50	50	100	ES
16FD306	THERMODYNAMICS	I,II	a,b,c,d	2	2	0	3	50	50	100	ES
16FD307	ENGINEERING PROPERTIES LAB	I,II	a,c,d,f,g,i	0	0	2	1	50	50	100	PC
16FD308	FOOD MICROBIOLOGY LAB	I,II,III	a,d,f,g,i	0	0	2	1	50	50	100	PC
16FD309	MINI PROJECT I	I	a-l	0	0	2	1	100	-	100	EEC
15GE310	LIFE SKILLS: BUSINESS ENGLISH$^{\Phi}$	I	j	0	0	2	-	100	-	100	EEC
Total				**17**	**6**	**10**	**24**	**600**	**400**	**1000**	**-**
FOURTH SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**Pos**					**CA**	**ES**	**Total**	
15MA401	NUMERICAL METHODS AND STATISTICSβ	I	a,b	2	2	0	3	50	50	100	BS
16FD402	PRINCIPLES OF FOOD PROCESSING	I,II,III	a,b,c,d,e,f,l	3	2	0	4	50	50	100	PC
16FD403	INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY	I.II	a,b,d,e	3	0	0	3	50	50	100	PC
16FD404	HEAT AND MASS TRANSFER	I,II	a,b,d,e	3	2	0	4	50	50	100	ES
16FD405	COMPUTER APPLICATION IN FOOD INDUSTRY	I,II,III	a,b,e,h,i	3	0	0	3	50	50	100	PC
16FD406	REFRIGERATION AND AIR CONDITIONING FOR FOOD PROCESSING	I,II	a,b,c,d,l	3	0	0	3	50	50	100	PC
16FD407	HEAT AND MASS TRANSFER LAB	I,II	a,b,d,e,i	0	0	2	1	50	50	100	ES
16FD408	PRINCIPLES OF FOOD PROCESSING LAB	I,II	a,b,c,d,f,g,i	0	0	2	1	50	50	100	PC
16FD409	MINI PROJECT II	I, III	a-l	0	0	2	1	100	-	100	EEC
15GE410	LIFE SKILLS: VERBAL ABILITY$^{\Phi}$	I	j	0	0	2	-	100	-	100	EEC
Total				**17**	**6**	**8**	**23**	**600**	**400**	**1000**	

$^{\alpha}$ Common to all branches of B.E./B.Tech. except CSE

$^{\Phi}$ Common to all branches of B.E./B.Tech (Non-Credit Course)

$^{\beta}$ Common to AU,ME,MTRS,EEE,EIE,BT,TT,FT,FD

FIFTH SEMESTER												
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			**Category**
		PEOs	**POs**					**CA**	**ES**	**Total**	
16FD501	BAKING AND CONFECTIONERY TECHNOLOGY	I,II	b,d,e,g,l	3	0	0	3	50	50	100	PC
16FD502	MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY	I,II	a,b,d,e,f,g	3	0	0	3	50	50	100	PC
16FD503	DESIGN OF FOOD PROCESSING EQUIPMENT	I,II,III	a,b,c,d,e,g,l	3	2	0	4	50	50	100	PC
16FD504	CHEMISTRY OF FOOD PROCESSING	I,II,III	a,b,f,g,l	3	0	0	3	50	50	100	PC
	ELECTIVE I	-	-	3	0	0	3	50	50	100	PE
	ELECTIVE II	-	-	3	0	0	3	50	50	100	PE
16FD507	CHEMISTRY OF FOOD PROCESSING LABORATORY	I,II	a,b,f,g	0	0	2	1	50	50	100	PC
16FD508	BAKING AND CONFECTIONERY LABORATORY	I,II	a,b,d,e,g,i	0	0	2	1	50	50	100	PC
16FD509	TECHNICAL SEMINAR I	II, III	i,j	0	0	2	1	100	-	100	EEC
16FD510	MINI PROJECT III	I	a-l	0	0	2	1	100	-	100	EEC
15GE511	LIFE SKILLS: APTITUDE I[Φ]	III	a,b	0	0	2	-	100	-	100	EEC
Total				**18**	**2**	**10**	**23**	**700**	**400**	**1100**	

SIXTH SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			
		PEOs	**POs**					**CA**	**ES**	**Total**	**Category**
15GE601	PROFESSIONAL ETHICS[+]	II	f,g,h	2	0	0	2	50	50	100	HSS
16FD602	WASTE MANAGEMENT IN FOOD INDUSTRIES	I,II,III	a,b,f,l	3	0	0	3	50	50	100	PC
16FD603	DAIRY TECHNOLOGY	I,II,III	a,b,c,d,e,f,g,l	3	0	0	3	50	50	100	PC
16FD604	FRUITS AND VEGETABLE PROCESSING TECHNOLOGY	I,II,III	a,b,c,d,e,f,g,l	3	0	0	3	50	50	100	PC
	ELECTIVE III	-	-	3	0	0	3	50	50	100	PE
	ELECTIVE IV	-	-	3	0	0	3	50	50	100	PE
16FD607	DAIRY TECHNOLOGY LABORATORY	I,II	a,b,c,d,e,i	0	0	2	1	50	50	100	PC
16FD608	FRUITS AND VEGETABLE PROCESSING TECHNOLOGY LABORATORY	I,II	a,b,c,d,e,i	0	0	2	1	50	50	100	PC
16FD609	TECHNICAL SEMINAR II	II,III	j	0	0	2	1	100	-	100	EEC
16FD610	MINI PROJECT IV	I	a-l	0	0	2	1	100	-	100	EEC
15GE611	LIFE SKILLS: APTITUDE II[Φ]	III	a,b	0	0	2	-	100	-	100	EEC
Total				**17**	**0**	**10**	**21**	**700**	**400**	**1100**	**-**

[Φ] Common to all branches of B.E./B.Tech (Non-Credit Course)

[+] Common to Common to AE, AG,AU,CE,ME,MTRS,BT,FT,FD,TT (VI Semester) and to CSE,ECE,EEE,EIE,IT (VII Semester)

SEVENTH SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			
		PEOs	**Pos**					**CA**	**ES**	**Total**	**Category**
15GE701	ENGINEERING ECONOMICS[$]	II	a,f,g,k,l	3	0	0	3	50	50	100	HSS
16FD702	FOOD PACKAGING TECHNOLOGY	I,II,III	a,b,c,d,e,h,l	3	0	0	3	50	50	100	PC
16FD703	FOOD PLANT LAYOUT AND MANAGEMENT	I,II	a,c,h,i,k,l	3	2	0	4	50	50	100	PC
16FD704	FOOD SAFETY AND QUALITY REGULATIONS	I,II,III	b,c,d,e,f,g	3	0	0	3	50	50	100	PC
	ELECTIVE V	-	-	3	0	0	3	50	50	100	PE
	ELECTIVE VI	-	-	3	0	0	3	50	50	100	PE
16FD707	FOOD PACKAGING LABORATORY	I,II	a,b,c,d,h,i,l	0	0	2	1	50	50	100	PC
16FD708	FOOD ANALYSIS AND QUALITY CONTROL LABORATORY	I,II	b,c,e,f,i	0	0	2	1	50	50	100	PC
16FD709	MINI PROJECT V	I	a-l	0	0	2	1	100	-	100	EEC
15GE710	LIFE SKILLS : COMPETITIVE EXAMS[Φ]	I	a,b,l	0	0	2	-	100	-	100	EEC
Total				**18**	**2**	**8**	**22**	**600**	**400**	**1000**	**-**
EIGHTH SEMESTER											
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Maximum Marks**			
		PEOs	**Pos**					**CA**	**ES**	**Total**	**Category**
	ELECTIVE VII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE VIII	-	-	-	-	-	3	50	50	100	PE
	ELECTIVE IX	-	-	-	-	-	3	50	50	100	PE
16FD804	PROJECT WORK	I,II,III	a-l	-	-	18	9	50	50	100	EEC
Total				**-**	**-**	**18**	**18**	**50**	**50**	**100**	**-**

[$] Common to Common to CSE,ECE,EEE,EIE,IT (VI Semester) and to AE, AG,AU,CE,ME,MTRS,BT,FT,TT,FD (VII Semester)

[Φ] Common to all branches of B.E./B.Tech (Non-Credit Course)

Electives							
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**
		PEOs	**POs**				
LANGUAGE ELECTIVES							
15LE101	BASIC ENGLISH I	II	j	3	0	0	3
15LE102	COMMUNICATIVE ENGLISH I	II	j	3	0	0	3
15LE201	BASIC ENGLISH II	II	j	3	0	0	3
15LE202	COMMUNICATIVE ENGLISH II	II	j	3	0	0	3
15LC203	CHINESE	II	j	3	0	0	3
15LF203	FRENCH	II	j	3	0	0	3
15LG203	GERMAN	II	j	3	0	0	3
15LH203	HINDI	II	j	3	0	0	3
15LJ203	JAPANESE	II	j	3	0	0	3
PHYSICS ELECTIVES							
15PH201	PHYSICS OF MATERIALS	I	a	3	0	2	4
15PH202	APPLIED PHYSICS	I	a	3	0	2	4
15PH203	MATERIALS SCIENCE	I	a	3	0	2	4
15PH204	PHYSICS OF ENGINEERING MATERIALS	I	a	3	0	2	4
15PH205	SOLID STATE PHYSICS	I	a	3	0	2	4
CHEMISTRY ELECTIVES							
15CH201	ENGINEERING CHEMISTRY	I	a	3	0	2	4
15CH202	APPLIED CHEMISTRY	I	a	3	0	2	4
15CH203	APPLIED ELECTROCHEMISTRY	I	a	3	0	2	4
15CH204	INDUSTRIAL CHEMISTRY	I	a	3	0	2	4
15CH205	WATER TECHNOLOGY AND GREEN CHEMISTRY	I	a	3	0	2	4
DISCIPLINE ELECTIVES							
16FD001	MILK AND MILK PRODUCTS TECHNOLOGY	II	a,c,f,i,k,l	3	0	0	3
16FD002	CEREAL, PULSES AND OILSEED TECHNOLOGY	I,III	a,b,c,d,l	3	0	0	3
16FD003	CROP PROCESS ENGINEERING	II,III	a,e,l	3	0	0	3
16FD004	MILLING TECHNOLOGY	II,III	a,c,e,f,l	3	0	0	3
16FD005	ADVANCED DRYING TECHNOLOGY	I,III	a,b,c,e,l	3	0	0	3
16FD006	EXTRUSION TECHNOLOGY	I,II	a,c,e,f,l	3	0	0	3
16FD007	APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING	I,III	a,b,d,g,i	3	0	0	3
16FD008	RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS	I,III	a, d, c,l	3	0	0	3

16FD009	FOOD COLORS AND FLAVOR TECHNOLOGY	I	a,g,l	3	0	0	3
16FD010	BEVERAGE PROCESSING	II,III	a,b,d,f,g	3	0	0	3
16FD011	SUGAR TECHNOLOGY	I,III	a,b,c,f	3	0	0	3
16FD012	FUNCTIONAL FOODS AND NUTRACEUTICALS	I,II	a,b,d,f,l	3	0	0	3
16FD013	READY TO EAT FOODS	II	a,b,g	3	0	0	3
16FD014	DESIGN AND FORMULATION OF FOODS	I	a,b,c,e	3	0	0	3
16FD015	FOOD BIOTECHNOLOGY	I,III	a,b,e,f	3	0	0	3
16FD016	FOOD ALLERGY AND TOXICOLOGY	II	a,b,f,g	3	0	0	3
16FD017	MUSHROOM PROCESSING TECHNOLOGY	II	a,b,d,f,l	3	0	0	3
16FD018	PLANTATION AND SPICE PROCESSING	II,III	a,b,d,l	3	0	0	3
16FD019	PROCESS ECONOMICS & INDUSTRIAL MANAGEMENT	I	a,f,g,i,k,l	3	0	0	3
16FD020	ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGISTS	I	d,e,h,i,l	3	0	0	3
16FD021	ENTERPRISE RESOURCE PLANNING (ERP)	I	a,d,h,i,k,l	3	0	0	3
16FD022	SUPPLY CHAIN AND RETAIL MANAGEMENT	I,III	a,d,f,g,h,i,j	3	0	0	3
16FD023	TOTAL QUALITY MANAGEMENT (TQM)	II,III	a,b,d,f,g,i,l	3	0	0	3
16FD024	SENSORY EVALUATION OF FOODS	II	a,b,d,f,l	3	0	0	3
16FD025	EMERGING TECHNOLOGIES IN FOOD PROCESSING	I,III	a,b,c,d,e,l	3	0	0	3
ENTREPRENEURSHIP ELECTIVES							
15GE001	ENTREPRENEURSHIP DEVELOPMENT I	I,II,III	j,l	3	0	0	3
15GE002	ENTREPRENEURSHIP DEVELOPMENT II	I,II,III	j,l	3	0	0	3
PHYSICAL SCIENCE ELECTIVES							
15GE0P1	NANOMATERIALS SCIENCE	I,II	a	3	0	0	3
15GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	I,II	a	3	0	0	3
15GE0P3	APPLIED LASER SCIENCE	I,II	a	3	0	0	3
15GE0C1	CORROSION SCIENCE	I,II	a	3	0	0	3
15GE0C2	ENERGY STORING DEVICES AND FUEL CELLS	I,II	a	3	0	0	3
15GE0C3	POLYMER CHEMISTRY AND PROCESSING	I,II	a	3	0	0	3
OPEN ELECTIVES							
16FD0YA	TRADITIONAL FOODS	II	a,b,k	3	0	0	3
16FD0YB	FOOD LAWS AND REGULATIONS	II,III	b,f,g,h,i,j	3	0	0	3
16FD0YC	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	I,II	a,b,c,d,e,f,g,l	3	0	0	3
ONE CREDIT COURSES							
16FD0XA	FOOD FERMENTATION TECHNOLOGY	I,III	a,b,d,g,	-	-	-	1
16FD0XB	HALAL COMPLIANCE IN FOOD AUDIT	I,III	a,b,d,g	-	-	-	1

ADDITIONAL ONE CREDIT COURSES (I to III Semesters)								
15GE0XA	HEALTH AND FITNESS	-	-	-	-	-	1
15GE0XB	FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY	-	-	-	-	-	1
15GE0XC	VEDIC MATHEMATICS	-	-	-	-	-	1
15GE0XD	INTRODUCTION TO ALGORITHMS	-	-	-	-	-	1
15GE0XE	ETYMOLOGY	-	-	-	-	-	1
15GE0XF	HINDUSTANI MUSIC	-	-	-	-	-	1
15GE0XG	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	-	-	-	1
15GE0XH	AGRICULTURE FOR ENGINEERS	-	-	-	-	-	1
15GE0XI	INTRODUCTION TO DATA ANALYSIS USING SOFTWARE	-	-	-	-	-	1
15GE0XJ	ANALYSIS USING PIVOT TABLE	-	-	-	-	-	1
15GE0XL	INTERVIEW SKILLS	-	-	-	-	-	1
15GE0XN	JOURNALISM AND MASS COMMUNICATION	-	-	-	-	-	1
15GE0XO	VISUAL MEDIA AND FILM MAKING	-	-	-	-	-	1
15GE0XP	YOGA FOR HUMAN EXCELLENCE	-	-	-	-	-	1
15GE0XQ	CARNATIC MUSIC	-	-	-	-	-	1
15GE0XR	GENERAL PSYCOLOGY	-	-	-	-	-	1
15GE0XS	NEURO BEHAVIOURAL SCIENCE	-	-	-	-	-	1
15GE0XT	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	-	-	-	1
15GE0XW	DISRUPTIVE INNOVATION BASED START UP ACTIVITIES	-	-	-	-	-	1
15GE0XX	VISION INDIA	-	-	-	-	-	1
VALUE ADDED COURSES								
BRIDGE COURSES								
16FDB01	FOOD BIOCHEMISTRY							
16FDB02	ENGINEERING PHYSICS							

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	7	12	4	3					26	15	15%	20%
2	ES	4	9	7	5					25	14	15%	20%
3	HSS	6	3				2	3		14	8	5%	10%
4	PC	3		12	14	15	11	12		67	38	30%	40%
5	PE					6	6	6	9	27	15	10%	15%
6	EEC			1	1	2	2	1	9	16	9	10%	15%
Total		20	24	24	23	23	21	22	18	175	-	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

15MA101 MATRICES AND CALCULUS 3 2 0 4

Course Objectives

- Interpret the introductory concepts of Matrices and Calculus, which will enable them to model and analyze physical phenomena involving continuous changes of variables
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Matrices and Calculus.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Analyze the characteristics of a linear system with eigen values and vectors.
2. Identify and model the real time problem using first order linear differential equations.
3. Apply the suitable techniques and solve the higher order ordinary differential equations.
4. Characterize the functions and get the solutions of the unconstrained maxima and minima
5. Evaluate the functions to get the surface area and volume using multiple integral.

Articulation Matrix

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

UNIT I **15 Hours**

MATRICES

Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values-Stretching of elastic membranes. Cayley - Hamilton Theorem - Quadratic form: Reduction of a quadratic form to a canonical form.

UNIT II **14 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER

Leibnitz's Equations - Modelling and solutions using Newtons law of cooling of bodies - solutions to R-L and R-C electric circuits.

UNIT III **16 Hours**

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

Linear differential equations of second and higher order with constant coefficients. Linear differential equations of higher order with variable coefficients: Cauchys linear differential equation - Method of variation of parameters for second order differential equations.

UNIT IV **15 Hours**

MULTIVARIABLE CALCULUS

Functions of Two Variables and their solutions- Total Differential - Derivative of implicit functions- Jacobians Unconstrained maxima and minima.

UNIT V **15 Hours**

MULTIPLE INTEGRALS

Double integration with constant and variable limits-Region of integration -Change the order of integration -Area as double integral in cartesian coordinates. Triple integral in Cartesian coordinates.

FOR FURTHER READING

Applications of mass spring system in ordinary differential equations of higher order

Total: 75 Hours

Reference(s)

1. C. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015.
3. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
4. B.S. Grewal, Higher Engineering Mathematics, Forty Third Edition, Khanna Publications , New Delhi 2014.
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.
6. T.Veerarajan, Engineering mathematics for First Year,Tata McGraw-Hill Publishing company Limited, New Delhi, 2014.

15PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- To impart knowledge in properties of matter, crystallography and ultrasonics
- To understand the applications of lasers and fiber optics
- To implement the principles of quantum physics in the respective engineering fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyze the concept of properties of matter and apply the same for practical applications
2. Identify the suitable laser source for fiber optic communication applications

3. Analyze the properties of ultrasonic waves and apply the same for day today applications
4. Classify the different types of crystal structures and analyze their properties
5. Apply the Schrodinger wave equation to illustrate the motion of quantum particles

Articulation Matrix

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

UNIT I **8 Hours**

PROPERTIES OF MATTER

Elasticity: elastic and plastic materials - Hooke's law - elastic behavior of a material -stress -strain diagram- factors affecting elasticity. Three moduli of elasticity- Poisson's ratio-torsional pendulum-twisting couple on a cylinder. Young's modulus- uniform bending -non- uniform bending. Viscosity: coefficient of viscosity -streamline and turbulent flow -experimental determination of viscosity of a liquid -Poiseuille's method.

UNIT II **6 Hours**

APPLIED OPTICS

Interference: air wedge- theory- uses- testing of flat surfaces- thickness of a thin wire. Laser: introduction- principle of laser- characteristics of laser- types: CO2 laser -semiconductor laser (homo junction). Fiber optics: principle of light transmission through fiber- expression for acceptance angle and numerical aperture- types of optical fibers (refractive index profile and mode)- fiber optic communication system (block diagram only).

UNIT III **5 Hours**

ULTRASONICS

Ultrasonics: introduction- properties of ultrasonic waves-generation of ultrasonic waves-magnetostriction- piezo electric methods- detection of ultrasonic waves. Determination of velocity of ultrasonic waves (acoustic grating). Applications of ultrasonic waves: SONAR- measurement of velocity of blood flow -study of movement of internal organs.

UNIT IV **5 Hours**

SOLID STATE PHYSICS

Crystal Physics: lattice -unit cell -crystal systems- Bravais lattices- Miller indices- 'd' spacing in cubic lattice- calculation of number of atoms per unit cell, atomic radius, coordination number and packing density for SC, BCC, FCC and HCP structures- X-ray diffraction: Laue's method - powder crystal method.

UNIT V **6 Hours**

QUANTUM MECHANICS

Quantum Physics: development of quantum theory- de Broglie wavelength -Schrodinger's wave equation- time dependent and time independent wave equations- physical significance. Application: particle in a box (1d)- degenerate and non-degenerate states. Photoelectric effect: quantum theory of light work function- problems.

FOR FURTHER READING
Neutrions - expanding universe

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Determine the moment of inertia of the disc and calculate the rigidity modulus of a given wire using torsion pendulum (symmetrical masses method).

3 **4 Hours**

EXPERIMENT 2

Find the elevation of the given wooden beam at the midpoint by loading at the ends and hence calculate the Youngs modulus of the material.

4 **4 Hours**

EXPERIMENT 3

Find the depression at the midpoint of the given wooden beam for 50g, 100 g, 150 g, 200 g and 250 g subjected to non-uniform bending and determine the Youngs modulus of the material of the beam.

5 **4 Hours**

EXPERIMENT 4

Determine the coefficient of viscosity of the given liquid by Poiseulles method.

6 **4 Hours**

EXPERIMENT 5

Form the interference fringes from the air wedge setup and calculate the thickness of the given wire.

7 **4 Hours**

EXPERIMENT 6

By applying the principle of diffraction, determine the wavelength of given laser and the average particle size of lycopodium powder using laser source.

8 **4 Hours**

EXPERIMENT 7

Determine the
(i) wavelength of ultrasonics in a liquid medium,
(ii) velocity of ultrasonic waves in the given liquid
(iii) compressibility of the given liquid using ultrasonic interferometer.

Total: 60 Hours

Reference(s)

1. D. S. Mathur, Elements of Properties of Matter, 5th edition, S Chand & Company Ltd., New Delhi, 2012.
2. Charles Kittel, Introduction to Solid State Physics, 8th edition, Wiley India Pvt. Ltd., New Delhi, 2012.

3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. B. K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012.
5. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
6. Ian Morison, Introduction to Astronomy and Cosmology, John Wiley and Sons, Ltd., 2013.

15CH103 ENVIRONMENTAL SCIENCE 2 0 2 3

Course Objectives

- Realize the interdisciplinary and holistic nature of the environment
- Understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development
- Recognize the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Assess the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources.
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation.
3. Identify the existing environmental challenges related to pollution and its management.
4. Select suitable strategies for sustainable management of components of environmental.
5. Correlate the impacts of population and human activities on environment.

Articulation Matrix

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

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification) - water logging - salinity - case studies. Energy resources: renewable (solar, wind, tidal, geothermal and hydroelectric power) - non renewable energy sources

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: forest ecosystem - desert ecosystem - ecological succession. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity - field study

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - marine pollution - thermal pollution - noise pollution. Disaster management: causes - effects - control measures of floods - earthquake - cyclone - landslides

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - urban problems related to energy. Environmental ethics - issues and possible solutions - solid waste management - causes - effects - 3R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. Environment protection act: Air (Prevention and control of pollution) act - wildlife protection act

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - women and child welfare programmes - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights:E - waste and biomedical waste -Identification of adulterants in food materials

1 **2 Hours**

EXPERIMENT 1

General instructions to students for handling the reagents and safety precautions.

2 **4 Hours**

EXPERIMENT 2

Estimation of dissolved oxygen in a water sample/sewage by Winklers method

3 **4 Hours**

EXPERIMENT 3

Estimation of chloride content in water by argentometric method

4 **4 Hours**

EXPERIMENT 4

Estimation of calcium in lime by complexometric method

5 **4 Hours**

EXPERIMENT 5

Estimation of chromium in leather tannery effluents

6 **4 Hours**

EXPERIMENT 6

Determination of percentage purity of washing soda

7 **4 Hours**

EXPERIMENT 7

Estimation of heavy metals in the given solution by EDTA method

8 **4 Hours**

EXPERIMENT 8

Determination of Prussian blue dye concentration by spectrophotometer

Total: 60 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. A. Ravikrishnan, Environmental Science and Engineering, 5th revised Edition, Sri Krishna Hitech Publishing company (P) Ltd, Chennai, 2010
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. E. Bharucha, Textbook of Environmental studies, second Edition, Universities Press Pvt. Ltd., New Delhi, 2013
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

15GE105 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To Learn the fundamentals of communication systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply the fundamental laws to electric circuits and compute the different alternating quantities.
2. Apply the laws of magnetism for the operation of DC motor.
3. Examine the construction and working principle of different AC machines
4. Analyze the different speed control methods of DC motors and special machines.
5. Analyze the performance characteristics and applications of semiconductor devices.

Articulation Matrix

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

UNIT I **7 Hours**

ELECTRIC CIRCUITS

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchoffs Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

UNIT II **5 Hours**

DC MACHINES

Introduction of magnetic circuits - Law of Electromagnetic induction, Flemings Right & Left hand rule- Types of induced emf - Definition of Self and Mutual Inductance - DC Motor- Construction - Working Principle- Applications.

UNIT III **6 Hours**

AC MACHINES

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Construction - Working Principle - Applications.

UNIT IV **5 Hours**

ELECTRICAL DRIVES

Speed control of dc shunt motor and series motor - Armature voltage control - Flux control - Construction and operation of DC servo motor - Construction and operation of DC servo motor stepper motor.

UNIT V **7 Hours**

ELECTRON DEVICES AND COMMUNICATION

Characteristics of PN Junction diode and Zener diode - Half wave and Full wave Rectifiers - Bipolar Junction Transistor - Operation of NPN and PNP transistors - Logic gates - Introduction to communication systems.

FOR FURTHER READING

Voltage Regulator - Stepper motor - Energy meter - SMPS, Satellite and Optical communication.

1 **4 Hours**

EXPERIMENT 1

Analyze the VI characteristics of a fixed resistor and a lamp by varying its temperature.

2 **4 Hours**

EXPERIMENT 2

Apply the voltage division and current division techniques for series and parallel connections of lamp loads.

3 **4 Hours**

EXPERIMENT 3

Understand the concept of electromagnetic induction using copper coil.

4 **4 Hours**

EXPERIMENT 4

Understand the construction and working principle of DC machines.

5 **6 Hours**

EXPERIMENT 5

Determine the VI Characteristics of PN Junction diode and plot the input and output wave shapes of a half wave rectifier.

6 **4 Hours**

EXPERIMENT 6

Realize the working of transistor as an electronic switch through experiments.

7 **4 Hours**

EXPERIMENT 7

Lighting applications using logic gates principle.

Total: 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010
3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013
5. Muthusubramanian & Salivahanan, Basic Electrical and Electronics Engineering and Communication Engineering, Seventh Edition, Tata MCGraw Hill Education Private Limited, 2011

16FD106 FOOD BIOCHEMISTRY 3 0 0 3

Course Objectives

- Impart knowledge on fundamentals of food chemistry
- Understand the properties and composition of food
- Identify the nutrient and non-nutritive components of food and their composition

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Evaluate the importance of carbohydrate, proteins, fat, minerals, vitamins and water in food
2. Analyse the properties of proteins and carbohydrates in foods
3. Explain the classification and properties of fats and oil and evaluate its applications in food industries
4. Explain the sources, functions and deficiency of vitamins and minerals in food
5. Apply the principles and concepts of pigments, flavor and enzymes in food processing and preservation

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION TO FOOD COMPONENTS AND WATER IN FOOD

Importance of food, Scope of food chemistry - Introduction to different food groups: their classification and importance, Food as a source of energy, Consumer safety - Water -Structure of water molecule, types and properties of water, water activity and its importance, water quality for food processing -role of water in food preservation and shelf-life.

UNIT II **10 Hours**

CARBOHYDRATES AND PROTEINS IN FOOD

Carbohydrates -Definition, classification, sources, chemical make-up, sensory properties-sweetness index, caramelization, Maillard reaction, nutritional and industrial importance, Sugar alcohols, Starches in food, thickening & gelatinization process, modified starch, Dextrins and dextrans - nutritive value of starch in food- Proteins - Sources, chemical make-up, properties, nutritional aspects amino acids, amino essential acids, biological value, Protein Efficiency Ratio (PER), functional roles of proteins in food and industrial importance.

UNIT III **8 Hours**

FATS AND OILS IN FOOD

Fats -Sources, chemical make-up, properties, nutritional aspects - essential fatty acids, Polyunsaturated Fatty Acids (PUFA), hydrogenation, rancidity, emulsification, shorten value of different fats - low fat and no fat food, fat replacements, industrial-importance of lipids

UNIT IV **9 Hours**

IMPORTANCE OF VITAMINS AND MINERALS IN FOOD

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

UNIT V **11 Hours**

PIGMENTS, FLAVOR COMPONENTS AND ENZYME IN FOOD

Food Pigments-Importance, types and sources of pigments - their changes during processing and storage, carotenoids, tannins- Flavor and aroma components present in various crop products and fermented foods, synthetic colors and naturally similar /artificial flavors, threshold values, off flavors & food taints - stabilizers, preservatives, sweeteners - Enzymes -Definition, importance, sources, nomenclature, classification - application of enzymes in food processing.

FOR FURTHER READING

Biological role of dietary fibers, plasticizing properties of fats- enrobing fats, balanced diet, malnutrition, nutrient supplementation, enzyme kinetics, factors affecting enzyme action-immobilized enzymes, proximate composition of food, food composition database

Total: 45 Hours

Reference(s)

1. Cox, M.M. and Nelson, David L. Lehininger, Principles of Biochemistry. 5th Edition.H.Freeman,2008
2. Belitz H.-D, Grosch W and Schieberle P. Food Chemistry, 3rd Revised Edition, Springer-Verlag, 2004
3. Chopra,H.K., and Panesar,P.S. Food Chemistry. Narosa Publishing House. 2015
4. Murray, Robert K. etal.,Harper's,Illustrated Biochemistry,27th Edition. McGraw-Hill,2006
5. Meyer, Lillian Hoagland,Food Chemistry. CBS Publishers,1987
6. DeMan, John M., Principles of Food Chemistry. 3rd Edition, Springer, 1999

15GE107 WORKSHOP PRACTICE **0 0 2 1**

Course Objectives

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making fitting joints and household pipe line connections using suitable tools.
- To develop the skills for preparing the green sand mould and to make simple household electrical connection
- To provide hands on training for dismantling and assembling of petrol engines, gear box and pumps.
- To develop the skills for making wood/sheet metal models using suitable tools

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
2. To gain the skills for making fitting joints and household pipe line connections using suitable tools.
3. Prepare green sand mould and make simple household electrical connections using suitable tools
4. Identify the petrol engines, gear box and pumps.
5. Make simple models using wood and sheet metal.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Forming of simple object in sheet metal using suitable tools (Example: Dust Pan / Soap Box)

2 **4 Hours**

EXPERIMENT 2

Fabrication of a simple component using thin and thick plates. (Example: Book rack)

3 **2 Hours**

EXPERIMENT 3

Making a simple component using carpentry power tools. (Example: Pen stand/Tool box/ Letter box].

4 **2 Hours**

EXPERIMENT 4

Prepare a "V" (or) Half round (or) Square joint from the given mild Steel flat.

5 **4 Hours**

EXPERIMENT 5

Construct a household pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend, Gate way and Taps (or) Construct a pipe connections of house application centrifugal pump using pipes, bend, gate valve, flanges and foot valve.

6 **4 Hours**

EXPERIMENT 6

Prepare a green sand mould using solid pattern/split pattern.

7 **4 Hours**

EXPERIMENT 7

Construct a domestic electrical wire connections using indicator, one way switch with calling bell, two way switch with lamp, one way switch with fan regulator and one way switch with socket.

8 **4 Hours**

EXPERIMENT 8

Dismantling and assembly of Centrifugal Monoblock / Gear Pump / Gear box.

9 **2 Hours**

EXPERIMENT 9

Dismantling and assembly of two stroke and four stroke petrol engine.

10 **2 Hours**

EXPERIMENT 10

Mini Project(Fabrication of Small Components).

Total: 30 Hours

15MA201 VECTOR CALCULUS AND COMPLEX ANALYSIS

3 2 0 4

Course Objectives

- Implement the Complex Analysis, an elegant method in the study of heat flow, fluid dynamics and electrostatics.
- Summarize and apply the methodologies involved in solving problems related to fundamental principles of Calculus viz: Differentiation, Integration and Vectors.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Determine & apply the important quantities associated with vector fields such as the divergence, curl and scalar potential.
2. Apply the theoretical aspects of vector integral calculus in their core areas.
3. Explain the differentiation properties of vectors.
4. Identify the complex functions and their mapping in certain complex planes.
5. Use the concepts of integration to complex functions in certain regions.

Articulation Matrix

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

UNIT I **16 Hours**

VECTOR CALCULUS

Gradient -Divergence -Curl - Directional derivative- Solenoidal -Irrotational vector fields -Line Integral -Surface integrals.

UNIT II **15 Hours**

INTEGRAL THEOREMS OF VECTOR CALCULUS

Green's theorem in a plane- Stoke's Theorem- Gauss divergence theorem- Applications involving cubes and parallelepiped.

UNIT III **14 Hours**

ANALYTIC FUNCTIONS

Analytic Functions- Necessary and Sufficient conditions of Analytic Function- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method -Applications to the problems of Potential Flow.

UNIT IV **14 Hours**

MAPPING OF COMPLEX FUNCTIONS

Physical interpretation of mapping- Application of transformation: translation, rotation, magnification and inversion of multi valued functions - Linear fractional Transformation (Bilinear transformation).

UNIT V **16 Hours**

INTEGRATION OF COMPLEX FUNCTIONS

Cauchy's Fundamental Theorem - Cauchy's Integral Formula - Taylor's and Laurent's series- Classification of Singularities - Cauchy's Residue Theorem.

FOR FURTHER READING

Applications to Electrostatic and Fluid Flow.

Total: 75 Hours

Reference(s)

1. C. Ray Wylie and C. Louis Barrett, Advanced Engineering Mathematics, Tata McGraw-HillPublishing Company Ltd, 2003
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited,New Delhi 2015
3. J. A. Brown and R. V. Churchill, Complex Variables and Applications , Sixth Edition, McGraw Hill,New Delhi, 1996
4. B. S. Grewal, Higher Engineering Mathematics, Forty third Edition, Khanna Publications , New Delhi 2014
5. Peter V. O. Neil, Advanced Engineering Mathematics, Seventh Edition ,Cengage Learning India Private Limited, 2012
6. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India,2007

15GE205 BASICS OF CIVIL AND MECHANICAL ENGINEERING

3 0 0 3

Course Objectives

- To impart basic knowledge in the field of Civil Engineering
- To guide students to select the good building materials
- To create awareness on various types of water supply and transportation systems
- To impart basic knowledge in the various engineering materials and manufacturing Processes.
- To understand the working principles of various Internal Combustion Engines, Refrigeration, Boiler and power plants.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the concepts and fundamental philosophies of Civil Engineering.
2. Classify the components of building with its functions and material qualities.
3. Identify various mechanical properties of materials and illustrate the various manufacturing processes
4. Classify and explain the working principles and operations of Internal Combustion Engines and Refrigeration cycles.
5. Identify different Energy sources and classify types of boilers, turbine and power plants.

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION TO CIVIL ENGINEERING

History, development and scope of Civil Engineering Functions of Civil Engineers. Construction Materials Characteristics of good building materials such as Stones Bricks -Cement - Aggregates and concrete. Surveying: Definition and purpose Classification Basic principles Measurement of length by chains and tapes.

UNIT II **7 Hours**

GENERAL FEATURES RELATING TO BUILDINGS

Selection of site Basic functions of buildings Major components of buildings. Types of foundation Bearing capacity of soils General Principles of Brick masonry Stone masonry Beams Lintels Columns Doors and windows Introduction to Green Building and Interior Design

UNIT III **7 Hours**

WATER SUPPLY AND TRANSPORTATION SYSTEMS

Sources of water Supply Methods of Rain Water Harvesting Flow Diagram of Water treatment Process Modes of Transportation Systems. Classification of Highways-Components of roads Bituminous and cement concrete roads. Importance of railways - Gauges Components of permanent way Types of bridges.

UNIT IV **8 Hours**

ENGINEERING MATERIALS AND MANUFACTURING PROCESSES

Materials classification, mechanical properties of cast iron, steel and high speed steel Casting process-Introduction to green sand moulding, pattern, melting furnace electric furnace Introduction to metal forming process and types Introduction to arc and gas welding Centre lathe, Drilling and Milling machines principal parts, operations.

UNIT V **8 Hours**

INTERNAL COMBUSTION ENGINES AND REFRIGERATION

Internal Combustion (IC) Classification, main components, working principle of a two and four stroke petrol and diesel engines, differences Refrigeration working principle of vapour compression and absorption system Introduction to Air conditioning.

UNIT VI **8 Hours**

ENERGY, BOILERS, TURBINE AND POWER PLANTS

Energy-Solar, Wind, Tidal, Geothermal, Biomass and Ocean Thermal Energy Conversion (OTEC)Boilers classification, Babcock and Wilcox and La-Mont Boilers, differences between fire tube and water tube boiler Steam turbines- working principle of single stage impulse and reaction turbines Power plant classification, Steam, Hydel, Diesel, and Nuclear power plants.

Total: 45 Hours

Reference(s)

1. N. Arunachalam, Bascis of Civil Engineering, Pratheeba Publishers, 2000
2. M. S. Palanichamy, Basic Civil Engineering, TMH, 2009
3. G. Shanmugamand M. S. Palanichamy, Basic Civil and Mechanical Engineering,Tata McGraw Hill Publishing Co., New Delhi, 2009
4. Pravin Kumar, Basic Mechanical Engineering, Pearson Education India, Pearson,2013.
5. G. Shanmugam and S. Ravindran, Basic Mechanical Engineering, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2013.
6. S. R. J. Shantha Kumar, Basic Mechanical Engineering, Hi-tech Publications, Mayiladuthurai, 2015

15GE206 COMPUTER PROGRAMMING 3 0 2 4

Course Objectives

- To learn the basics of computer organisation.
- To study the basics of C primitives, operators and expressions.
- To understand the different primitive and user defined data types.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Develop solutions using problem solving techniques and number system conversions
2. Develop programs using operators, type conversion and input-output functions
3. Apply decision making and looping statements in writing C programs
4. Apply the concepts of arrays and strings in developing C programs
5. Design applications using structures and functions in C

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO COMPUTERS

Introduction to computers - Characteristics of Computers - Evolution of Computers - Computer Generations - Basic Computer Organization - Number System - Problem Solving Techniques - Features of a Good Programming Language.

UNIT II **9 Hours**

INTRODUCTION TO C PROGRAMMING

Overview of C-Structure of C program-Keywords-Constants- Variables-Data types-Type conversion Operators and Expressions: Arithmetic-Relational-Logical-Assignment- Increment and Decrement-Conditional-Bitwise -Precedence of operators-Managing I/O operations-Formatted I/O-Unformatted I/O.

UNIT III **10 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement-if else statement-nesting of if else Statement-Switch Statement.Decision Making and Looping: while statement-do while statement-for statement-Nested for statement Jump Statements: goto-break-continue-return statement

UNIT IV **9 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one dimensional array, two-dimensional arrays, initializing two dimensional arrays, multi dimensional arrays. Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNIT V **9 Hours**

STRUCTURES AND FUNCTIONS

Structures and Unions: Introduction-defining a structure- declaring structure variables-accessing structure members- structure initialization-Unions-Enumerated data type
User Defined Functions: Elements of user defined functions -Definition of functions-return values and their types- function calls-function declaration-categories of function -call by value and call by reference-recursion-Preprocessor directives and macros.

FOR FURTHER READING

Creating and manipulating document using word - Mail merge - Creating spread sheet with charts and formula using excel - developing power point presentation with Animations - C graphics using built in functions

1 **2 Hours**

EXPERIMENT 1

Write a C program to perform arithmetic operations on integers and floating point numbers.

2 **2 Hours**

EXPERIMENT 2

Write a C program to implement ternary operator and relational operators.

3 **2 Hours**

EXPERIMENT 3

Write a C program to find the greatest of three numbers using if-else statement.

4 **4 Hours**

EXPERIMENT 4

Write a C program to display the roots of a quadratic equation with their types using switch case.

5 **4 Hours**

EXPERIMENT 5

Write a C program to generate pyramid of numbers using for loop.

6 **4 Hours**

EXPERIMENT 6

Write a C program to perform Matrix Multiplication

7 **4 Hours**

EXPERIMENT 7

Write a C program to check whether the given string is Palindrome or not.

8 **4 Hours**

EXPERIMENT 8

Write a C program to find the factorial of given number.

9 **4 Hours**

EXPERIMENT 9

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

details: rollno, name, branch, year, section, cgpa.

****

NAME:

ROLL NO:

BRANCH:

YEAR:

SECTION:

CGPA:

Total: 75 Hours

Reference(s)

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals, BPB publications, 2008
2. Ashok. N. Kamthane, Computer Programming, Second Edition, Pearson Education, 2012
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
5. Byron Gottfried, Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013

15GE207 ENGINEERING GRAPHICS 0 0 4 2

Course Objectives

- To learn conventions and use of drawing tools in making engineering drawings.
- To draw orthographic projections of points, line and solids.
- To draw the section of solids and development of surfaces of the given objects.
- To draw the isometric projections and perspective projections of the given solids.
- To introduce CAD software to draw simple two dimensional drawings.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the conventions and apply dimensioning concepts while drafting simple objects.
2. Draw the orthographic projection of points, line, and solids.
3. Draw the section of solid drawings and development of surfaces of the given objects.
4. Draw the isometric and perspective projection of the given objects.
5. Draw the simple two dimensional drawings using computer aided drawing tool.

Articulation Matrix

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

1 **12 Hours**

CONVENTIONS AND BASIC DRAWINGS

Importance - conventions - ISO and BIS - drawing tools and drawing sheets - lettering, numbering, dimensioning, lines and Symbols-Conic sections - types constructions -ellipse, parabola and hyperbola - eccentricity and parallelogram method.

2 **12 Hours**

ORTHOGRAPHIC PROJECTIONS

Principles - first and third angle projections - Points - first angle projection of points, straight lines - parallel, perpendicular and inclined to one reference plane, solid - cylinders, pyramids, prisms and cones.

3 **12 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACE

Section of solids - simple illustrations. Development of surfaces - cylinders, pyramids, prisms, cones and simple truncated objects.

4 **12 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTIONS

Importance - orthographic to isometric projection - simple and truncated solids- perspective projections of simple solids.

5 **12 Hours**

INTRODUCTION TO COMPUTER AIDED DRAWING (NOT FOR END SEMESTER EXAMINATION)

Basics commands of AutoCAD - two dimensional drawing, editing, layering and dimensioning - coordinate Systems -Drawing practice - orthographic views of simple solids using AutoCAD.

Total: 60 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International, 2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, BUREAU OF INDIAN STANDARDS-SP46, 2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V.Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
6. George Omura, Brian C. Benton, Mastering AutoCAD 2015 and AutoCAD LT 2015: Autodesk Official Press, Wiley Publisher, 2015.

15MA301 FOURIER SERIES AND TRANSFORMS 3 2 0 4

Course Objectives

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Summarize and apply the mathematical aspects that contribute to the solution of one dimensional wave equation
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Identify the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.
2. Formulate a function in frequency domain whenever the function is defined in time domain.
3. Apply the Fourier transform, which converts the time function into a sum of sine waves of different frequencies, each of which represents a frequency component.
4. Classify a partial differential equation and able to solve them.
5. Use the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.

Articulation Matrix

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

UNIT I **15 Hours**

FOURIER SERIES

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value.

UNIT II **16 Hours**

LAPLACE TRANSFORM

Laplace Transform- Existence Condition -Transforms of Standard Functions - Unit step function, Unit impulse function- Properties- Transforms of Derivatives and Integrals - Initial and Final Value Theorems - Laplace transform of Periodic Functions - Inverse Laplace transforms.

UNIT III **14 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity

UNIT IV **15 Hours**

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of Second Order Quasi Linear Partial Differential Equations - Fourier Series Solutions of One Dimensional Wave Equation - One Dimensional Heat Equation - Steady State Solution of Two-Dimensional Heat Equation - Fourier Series Solutions in Cartesian Coordinates.

UNIT V **15 Hours**

Z -TRANSFORM

Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution Method- Partial fraction method - Solution of Difference Equations using Z-Transform.

FOR FURTHER READING

Solutions of one dimensional wave equation and heat equations using Laplace transforms method.

Total: 75 Hours

Reference(s)

1. Larry.C.Andrews and Bhimsen.K.Shivamoggi, Integral Transforms for Engineers, First Edition, PHI Learning, New Delhi, 2007
2. Ian.N.Sneddan, The Use of Integral Transforms, Second Edition, McGraw Hill companies, 1972.
3. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, Inc, Singapore, 2008.
4. Peter V. O. Neil,Advanced Engineering Mathematics, Seventh Edition, Cenage Learning India Private Ltd, 2012.
5. B.S. Grewal, Higher Engineering Mathematics, Fortieth Edition, Khanna Publications, New Delhi 2007.
6. C. Ray Wylie and C. Louis Barrett,Advanced Engineering Mathematics, Tata McGraw-Hill Publishing Company Ltd, 2003.

16FD302 FOOD MICROBIOLOGY 3 0 0 3

Course Objectives

- Provide an idea about the general principles of food microbiology.
- Explain the interactions between microorganisms and food and factors influencing their growth and survival.
- Acquire knowledge about pathogens causing food borne infections and their detection methods

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Classify the microorganism and identify the microorganism associated with foods
2. Analyse the microorganism responsible for spoilage of foods and its assessments
3. Apply the preservation methods to control the spoilage and assess the microbial growth in foods
4. Analyze the importance of microorganism in food fermentation and fermented products
5. Assess the cause for food borne illness and Understand the quality control for safety of foods

Articulation Matrix

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

UNIT I **9 Hours**

MICROORGANISM IN FOOD

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

UNIT II **9 Hours**

MICROBIAL SPOILAGE OF FOODS AND THEIR CONTROL

Spoilage of foods, Principles and types of spoilage, Microbial spoilage of different types of foods, Spoilage of fruits and vegetables, Fresh and Processed meats, poultry sea foods, cereals, flour, dough, bakery products and dairy products, Use of antimicrobial agents, naturally occurring antimicrobial. Assessing microbial load in foods-microscopic, cultural, physical, chemical and immunological methods

UNIT III **9 Hours**

PRESERVATION OF FOODS

Food preservation, principles, factors affecting preservation, food preservation using temperature, low temperature food preservation, characteristics of psychrotrophs, high temperature food preservation, characteristics of thermophiles, water activity and its importance, preservation of foods by drying, chemicals and radiation, limitations, commercial applications.

UNIT IV **9 Hours**

MICROBES IN FOOD FERMENTATION

Importance of microbes in food fermentation, homo and hetero fermentative bacteria, yeasts and fungi, fermentation by lactic acid bacteria, alcoholic fermentation, yeast fermentation, characteristics and stain selection, fungal fermentation, Microbes associated with typical food fermentation, yogurt, cheese, fermented milk, breads, idli, soy products, fermented vegetables and meats.

UNIT V **9 Hours**

FOOD BORNE ILLNESS, MICROBIAL EXAMINATION ACTIVITY

Food borne infections, food poisoning, botulism, salmonellosis, gastroenteritis, food borne pathogens, Clostridium, Bacillus cereus, Staphylococcus aureus, Vibrio, Campylobacter, Yersinia, Detection and enumeration of microbes in foods, Indicator organisms and microbiological criteria, Rapid and automated microbial methods, development and impact on the detection of food borne pathogens, Application of various techniques in food industry, Detection methods of Escherichia coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl.botulinum and salmonella, Listeria monocytogenes, Food sanitation, indicators of food safety, coliform bacteria, food processing sanitation, microbiological standards and guidelines, HACCP, microbial quality control and food laws

FURTHER READING

Prebiotics, Probiotics, Fermenter, Enzymes from micro-organisms, Industrial uses of micro-organisms

Total: 45 Hours

Reference(s)

1. Vijaya Ramesh K,Food Microbiology,MJP Publishers,Chennai, 2005
2. James M,Jay,Martin J,Loessner and David A.Golden,Modern Food Microbiology, 7th Edition,Springer US,2005
3. M.R. Adams and M.O. Moss,Food Microbiology,New Age International Publishers Ltd,New Delhi,2008
4. W.C.Frazier,Dennis.C. Westhoff and N.M.Vanitha,Food Microbiology,McGraw-Hill bOOK CO,2013
5. S.J.Forsythe,The Microbiology of safe Food, Blackwell Science,2010
6. Wilkiw Harrigan,Laboratory Methods in Food Microbiology, rd Edition,Academic Press,1998

16FD303 ENGINEERING PROPERTIES OF FOOD MATERIALS

3 0 0 3

Course Objectives

- Assess physical, chemical and mechanical properties of food materials
- Understand rheological, thermal and electromagnetic properties of food materials
- Identify the usage of material handling equipment used in food processing operations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Apply the knowledge of physical properties in basic design of experiments
2. Understand the relationship between rheological properties and flow behavior of solid and liquid foods
3. Apply the facts of thermal properties in calculating the heat requirement for food process calculations
4. Analyse the role of frictional and aerodynamic properties involved in designing food processing equipment.
5. Analyse the optical and electromagnetic properties of food materials in designing sorting/grading equipment

Articulation Matrix

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

UNIT I **9 Hours**

PHYSICAL AND MECHANICAL PROPERTIES

Physical characteristics (size, shape, roundness, sphericity, geometric mean diameter, surface area, projected surface area, resemblance to geometric bodies, volume, bulk density, true density, specific gravity, porosity) and their measurement. Contact stress between bodies, Hertz problems, hardness, impact resistance, coefficient of restitution, fragility factor

UNIT II **9 Hours**

RHEOLOGICAL PROPERTIES

Stress, strain, elastic limit, modulus of elasticity, poissons ratio, shear strength, compressive strength, tensile strength, yield point, yield strength, deformation, bio yield point, rupture point, stiffness, elasticity, plasticity, degree of plasticity, toughness, resilience, mechanical hysteresis, viscoelasticity, stress relaxation, relaxation time, creep, retardation time, kinematic viscosity, apparent viscosity, Newtonian and non Newtonian fluid, ideal elastic behaviour (Hookean body), ideal plastic body (St. Venant body), ideal viscous behaviour (Newtonian liquid), time effects (viscoelasticity), texture profile (firmness/ hardness, cohesiveness, adhesiveness, etc).

UNIT III **9 Hours**

THERMAL PROPERTIES

Heat capacity, specific heat, latent heat, eutectic point, sensible heat, heat of absorption, heat of respiration, thermal conductivity, thermal diffusivity, modes of heat transfer, coefficient of thermal expansion, application of thermal properties in food processing operations

UNIT IV **9 Hours**

FRICTIONAL AND AERODYNAMIC PROPERTIES

Static and dynamic coefficient of friction, angle of repose, coefficient of internal friction, pressure ratio, asperity contact, rolling resistance, cohesion of granular materials, definition of deep and shallow bins, application of frictional properties in grain handling, processing and conveying. Terminal velocity, drag coefficient, Reynolds number, application of aerodynamic properties to agricultural products

UNIT V **9 Hours**

OPTICAL AND ELECTROMAGNETIC PROPERTIES

Colour, reflectance, diffraction, absorption, radiation, lightness, hue, chroma, saturation, value, gloss, tristimulus values of colour, CIE and Lab colour system, application of optical properties in food processing. Electrical and Electromagnetic properties, Electrical capacitance, resistance, spectrum of electromagnetic radiation, frequency of radiation, energy of radiation, black body, grey body, dielectric constant, dielectric loss, power factor, dielectric heating, dielectric loss tangent, application of electromagnetic properties in food processing

FOR FURTHER READING

Effect of moisture content on engineering properties- Application in food processing

Total: 45 Hours

Reference(s)

1. N.N. Mohesnin, Physical Properties of Plant and Animal Materials, Gordon and Breach Science Publishers, New York, 1970
2. M. A. Rao, S. S. H. Rizvi, Ashim K. data and Jasim Ahmed, Engineering Properties of Foods, CRC Press, Taylor and Francis group, 2014
3. R. Stroshine, Physical Properties of Agricultural Materials and Food Products, Purdue University, West Lafayette, Indiana, 2004
4. D.S. Mathur, Elements of Properties of Matter, S.Chand & Co. Publishers, New Delhi, 2010
5. Paul R Singh and Dennis Heldman, Introduction to Food Engineering, 5th Edition, Academic Press, 2013
6. G.V. Barbosa-CÃƒÂ¡novasay, Food Engineering Vol: I to IV, Encyclopedia of Life Support Systems (EOLSS), Eolss Publishers (A Nonprofit Global Effort), Oxford ,UK, [http://www.eolss.net], 2009.

16FD304 UNIT OPERATIONS IN FOOD PROCESSING

3 0 2 4

Course Objectives

- Impart knowledge on different unit operations and its significance in food Industry.
- Understand problems related to food processing and ability to solve.
- Familiarize with operational skill of equipment and imparting knowledge on entrepreneurship.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Find the application of different types of evaporators and understand the drying of principles.
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different particles present in foods.
3. Select the mixing equipment for dry powders, low or high viscosity liquids and acquire knowledge on importance of size reduction and energy requirement.

4. Organize the transformation of raw materials to quality food products using different processing technologies.
5. Apply the mechanism of crystallization and distillation process in food industries.

Articulation Matrix

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

UNIT I **8 Hours**

DRYING AND EVAPORATION

Unit operations in food processing - Drying - principles, theory of drying, equilibrium moisture content, methods of moisture determination and source of heat. Evaporation - definition - single and multiple effect evaporation-types, application and performances of evaporators and boiling point elevation - steam economy, mass and heat balance.

UNIT II **11 Hours**

MECHANICAL AND MEMBRANE SEPARATION

Velocity of particles moving in a fluid- terminal velocity, drag coefficient. Sedimentation, Stokes' law, sedimentation equipment, flotation, sedimentation of particles in a gas, settling under combined forces. Centrifugal Separation, centrifuge equipment. Filtration, filter cake resistance, constant - rate filtration, constant - pressure filtration, filtration graph. Filtration equipment, plate and frame filter press, rotary filters, centrifugal filters, air filters. Air Separators and Sieving: Cyclones - optimum shape efficiency, impingement separators, classifiers, rates of throughput, standard sieve sizes, cumulative analysis, particle size analysis, industrial sieves. Membrane Separation: osmotic pressure, ultra filtration, reverse osmosis, rate of flow through membranes.

UNIT III **7 Hours**

MIXING AND SIZE REDUCTION

Mixing - theory of solid and liquid mixing- equipment - effect on foods. 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 **9 Hours**

EXTRACTION AND LEACHING

Extraction process, rate of extraction, stage-equilibrium extraction, solvent extraction, supercritical fluid extraction, extraction equipment.Leaching: Principles of continuous leaching, counter current leaching, leaching equipments.

UNIT V **10 Hours**

CRYSTALLIZATION, DISTILLATION AND LEACHING

Crystallization - rate of crystal growth - equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers- Distillation: Distillation process - binary mixtures - flash and differential distillation-

steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch and fractional distillation - operation and process - advantages and limitations- distillation equipments -construction and operation - factors influencing the operation.

FOR FURTHER READING

Unit operations involved in various food processing operations (Milk industry, sugar industry, Bakery industry etc.)

1 **2 Hours**

EXPERIMENT 1

Determination of economy and thermal efficiency of evaporator

2 **2 Hours**

EXPERIMENT 2

Solving problems on single effect evaporator

3 **2 Hours**

EXPERIMENT 3

Solving problems on multiple effect evaporators

4 **2 Hours**

EXPERIMENT 4

Determination of separation efficiency of centrifugal separator

5 **2 Hours**

EXPERIMENT 5

Determination of collection efficiency in cyclone separator

6 **2 Hours**

EXPERIMENT 6

Determination of efficiency of liquid solid separation by filtration

7 **2 Hours**

EXPERIMENT 7

Determination of particle size of granular foods by sieve analysis

8 **2 Hours**

EXPERIMENT 8

Performance evaluation of a sieve

9 **2 Hours**

EXPERIMENT 9

Determination of performance characteristics in size reduction using the burr mill

10 **2 Hours**

EXPERIMENT 10

Determination of energy requirement in size reduction using ball mill

11 **2 Hours**

EXPERIMENT 11

Determination of energy requirement in size reduction using hammer mill

12 **2 Hours**

EXPERIMENT 12

Performance evaluation of pin mill

13 **2 Hours**

EXPERIMENT 13

Performance evaluation of a hammer mill

14 **2 Hours**

EXPERIMENT 14

Performance evaluation of a steam distillation process

15 **2 Hours**

EXPERIMENT 15

Visit to extraction and sugar industry

Total: 75 Hours

Reference(s)

1. R.L. Earle, Unit Operations in Food Processing, Butterworth-Heinemann Ltd; 2nd Revised edition, Pergamon Press, 1983.
2. C.J.Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
3. J.M. Coulson and J.F. Richardson, Chemical Engineering, Volume I to V, The Pergamon Press, New York, 1999.
4. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2001.
5. K. M. Sahay and K.K.Singh, Unit Operation of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
6. Albert Ibarz and G V Barbosa-CÃƒÂ¡novas, Unit Operations in Food Engineering, Food Preservation Technology Series, CRC Press, London, 2003.

16FD305 FLUID MECHANICS 3 2 0 4

Course Objectives

- To understand the basic properties of fluids and pressure measurement devices.
- To make familiar with calculation of forces in fluid structure interaction.
- To be familiar with all the basic working and calculation based on flow measurement devices.
- To derive the unit for any parameter using dimensional analysis.
- To understand the basic working principles of pumps and its application.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Understand the properties of fluids and calculations on pressure measurement devices
2. Demonstrate the calculation of forces in fluid structure interaction.
3. Implement the working and calculations on flow measurement devices.
4. Derive the units for any parameter using dimensional analysis.
5. Assess the working principles of pumps and its application.

Articulation Matrix

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

UNIT I **15 Hours**

PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENT

Continuum - Fluid - Types of fluid - Laws of fluid mechanics - Properties of Fluids - densities - kinematic viscosity, dynamic viscosity, capillarity - Surface tension, vapour pressure, measurement of pressure, manometers, U-tube manometer, differential manometer, inverted U-tube manometer.

UNIT II **15 Hours**

FLUID FLOW

Classification of Flow - velocity and acceleration of a fluid particle - Rotational - irrotational - circulation and vorticity - one dimensional, two dimensional, three dimensional flows, continuity equation in Cartesian co-ordinates. Flow pattern - stream line - equipotential line - stream tube - path line - steak line - flow net - velocity potential - stream function. Principles of conservation of mass - energy - momentum - Euler's equation of motion.

UNIT III **15 Hours**

FLOW MEASUREMENTS

Bernoulli's equation - applications - Venturimeter -Orifice. Flow through pipes - Navier stokes equation. Reynold's experiment - Darcy - Weisbach equation for friction head loss - Chezy's formula - minor losses in pipes - hydraulic gradient line - energy gradient line.

UNIT IV **15 Hours**

DIMENSIONAL ANALYSIS AND SIMILITUDE

Dimensional analysis - Principle of dimensional homogeneity - the Buckingham's Pi theorem - non-dimensional action of the basic equations- concept of geometries, kinematic and dynamic similarity. Important non-dimensional numbers - Reynolds, Froude, Euler dimensional analysis for scale up studies. Similitude - relationship between dimensional analysis and similitude.

UNIT V **15 Hours**

PUMPS

Fluid machines, Classification, Positive displacement, centrifugal pump, Gear pump, Diaphragm pumps, vacuum pump, metering pump, peristaltic pump, principles and application characteristics. Performance; selection and specification. Fans, blowers, aspirators and compressors. Selection, types and applications.

FOR FURTHER READING

Classification of models- characteristic curve for pumps

Total: 75 Hours

Reference(s)

1. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics-Fundamentals and Applications, Tata McGraw Hill Publishing Co, New Delhi, 2006.
2. R.K. Bansal, A text book of Fluid Mechanics and Hydraulic Machinery, Laxmi publications (P) Ltd, New Delhi, 2002.
3. K. Subramanya, Flow in Open Channels, Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. P.N. Modi and S.M. Seth, Hydraulics and fluid mechanics, Standard Publishers & Distributors, New Delhi.
5. RJ. Grade, Fluid mechanics through problems, Wiley eastern Ltd, Chennai, 2002.
6. Jagadish Lal, Hydraulic machines, Metropolitan book house, New Delhi, 2000.

16FD306 THERMODYNAMICS 2 2 0 3

Course Objectives

- To study the fundamentals of thermodynamics and First law.
- To provide knowledge on application of first law of thermodynamics.
- To impart knowledge on second law of thermodynamics and entropy.
- To study the thermodynamic properties of pure substances, its phase change processes and to study the working principle of steam boilers.
- To study the working principle of Carnot, Vapour compression, vapour absorption and air refrigeration systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the laws, concepts and principles of thermodynamics.
2. Apply first law of thermodynamics to closed and open systems.
3. Solve problems related to cycles and cyclic devices using second law of thermodynamics.
4. Calculate the thermodynamic properties of pure substances, its phase change processes and understand the working of steam boilers.
5. Understand the working of Carnot, Vapour compression, vapour absorption and air refrigeration systems.

Articulation Matrix

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

UNIT I **13 Hours**

BASIC CONCEPTS AND FIRST LAW

Thermodynamics, Terminologies, systems - classification - properties and state of a system. Thermodynamic process, cycle and equilibrium. Zeroth law of thermodynamics. Law of conservation of energy. Heat - specific heat - thermal capacity and water equivalent. Mechanical equivalent of heat, work - power - universal gas constant. Internal energy, enthalpy and molar specific heat of a gas. First law of thermodynamics - Limitations of first law of thermodynamics.

UNIT II **12 Hours**

APPLICATION OF FIRST LAW OF THERMODYNAMICS TO NON-FLOW AND FLOW PROCESSES

Work done during a non-flow process - Work done for constant volume, constant pressure, constant temperature, adiabatic and polytropic process. Application of first law of thermodynamics to a steady flow system - boiler, condenser, evaporator, nozzle, turbine, rotary and reciprocating compressor.

UNIT III **10 Hours**

SECOND LAW OF THERMODYNAMICS

Kelvin planck and Clausius statements. Heat engine, heat pump and refrigeration. Relation between heat and entropy - Importance and units of entropy - Clausius inequality - available and unavailable heat energy.

UNIT IV **15 Hours**

STEAM PROPERTIES AND BOILERS

Formation of steam at a constant pressure - Temperature vs total heat during steam formation. Wet, dry saturated and super heated steam - Dryness fraction of wet steam - Enthalpy and specific volume of steam - uses of steam tables. Boilers: Classification of steam boilers, Vertical and Cross tube Cradley boiler, Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories.

UNIT V **10 Hours**

REFRIGERATION SYSTEMS AND COMPONENTS

Principles of refrigeration, choice of refrigerants, components of refrigeration cycle. Types of refrigeration: Carnot refrigeration, vapor compression cycle, air refrigeration cycle, absorption refrigeration cycle.

FOR FURTHER READING

Heat engine and heat pump, Air standard Otto cycle, Air standard Diesel cycle, Air-standard Brayton cycle

Total: 60 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi,2003.
2. P.K.Nag, Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
3. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi,2011.
4. R.S.Khurmi, Steam table with Psychometric chart,S.Chand Publications, New Delhi,2009.
5. J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2002.
6. C.P.Arora, Thermodynamics, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2003.

16FD307 ENGINEERING PROPERTIES LAB 0 0 2 1

Course Objectives

- Impart knowledge on different engineering properties and their measurement
- Understand the properties of biological materials

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Explain the relationship between liquid foods and their flow properties
2. Demonstrate the use of engineering properties in design process
3. Understand the relevance of engineering properties in food industry
4. Illustrate the properties involved in material handling of food products
5. Apply knowledge on thermal properties to determine the heat capacity of materials

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1
Determination of shape of Grains in terms of sphericity

2 **2 Hours**

EXPERIMENT 2
Determination of Bulk density of grains

3 **4 Hours**

EXPERIMENT 3
Determination of True density and porosity of grains

4 **2 Hours**

EXPERIMENT 4
Experiment on measuring apparent viscosity of given fluid by Brookfield viscometer

5 **4 Hours**

EXPERIMENT 5
Determination of flow behavior (Newtonian fluid) of given fluid sample by brookfield viscometer

6 **4 Hours**

EXPERIMENT 6
Experiment on shear rate dependent Non-Newtonian fluid by brookfield viscometer

7 **4 Hours**

EXPERIMENT 7

Determination of firmness of given sample by texture analyser

8 **4 Hours**

EXPERIMENT 8

Determination of Filling and emptying angle of repose of the given grain

9 **2 Hours**

EXPERIMENT 9

Experiment on determining coefficient of external friction of grains

10 **2 Hours**

EXPERIMENT 10

Determination of colour of given solid and liquid sample using hunter lab / CIE colour system

Total: 30 Hours

Reference(s)

1. N.N. Mohesnin, Physical Properties of Plant and Animal Materials, Gordon and Breach Science Publishers, New York, 1970

16FD308 FOOD MICROBIOLOGY LAB **0 0 2 1**

Course Objectives

- Expose various microbial aspects of Food Processing
- Impart knowledge on identification of microbes using different technique and its enumeration methods
- Recognize the role of microbes in Food spoilage and preservation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Identify the sources of microorganism and its spoillage in food
2. Select the appropriate equipment for Microbiological works
3. Practice the different sterilization methods throughout the experiment
4. Inoculate,isolate and identify the microorganism from both liquid and solid samples
5. Understand the Principles of CCP(Critical Control Points) in Food safety

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Microscopic Methods in the Study of Microorganisms

2 **2 Hours**

EXPERIMENT 2

Sterilization Techniques and Equipment

3 **2 Hours**

EXPERIMENT 3

Preparation of Nutrient agar medium and Broth

4 **4 Hours**

EXPERIMENT 4

Isolation of Microorganism

5 **4 Hours**

EXPERIMENT 5

Purification of Microorganism

6 **2 Hours**

EXPERIMENT 6

Simple Staining Techniques

7 **2 Hours**

EXPERIMENT 7

Gram Staining of microbes

8 **2 Hours**

EXPERIMENT 8

Sampling and Serial Dilution of microbes in food products

9 **4 Hours**

EXPERIMENT 9

Enumeration of Lactic acid bacteria from fermented foods

10 **2 Hours**

EXPERIMENT 10

Yeast and Mould count from fruits

11 **4 Hours**

EXPERIMENT 11

Effect of cleaning and disinfection on microbial load

Total: 30 Hours

Reference(s)

1. James G.Cappuccino,Natalie Sherman,Microbiology: A laboratory Manual,5th edition,Benjamin/Cummings Science,1998

16FD309 MINI PROJECT I 0 0 2 1

Course Objectives

- To develop knowledge to formulate a real world problem and project goals.
- To identify the various tasks of the project to determine standard procedures
- To understand the various procedures for validation of the product and analyse the cost effectiveness
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations

Articulation Matrix

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

15MA401 NUMERICAL METHODS AND STATISTICS

2 2 0 3

Course Objectives

- By enrolling and studying this course the students will be able to understand the methods to solve polynomial equations and Implement the mathematical ideas for interpolation numerically
- Summarize and apply the methodologies involved in solving problems related to ordinary and partial differential equations
- Apply the concepts testing of hypothesis in their core areas
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Classify the equations into algebraic, transcendental or simultaneous and apply the techniques to solve them numerically
2. Demonstrate and obtain the differentiation and integration of functions using the numerical techniques
3. Obtain the solutions of all types of differential equations, numerically.
4. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.

5. Design an experiment for an appropriate situation using ANOVA technique.

Articulation Matrix

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

UNIT I **12 Hours**

SOLUTION OF EQUATIONS

Solution of algebraic and transcendental equations: Newton- Raphson method - Solution of system of linear equations: Gauss elimination method - Inverse of a matrix: Gauss-Jordan method- Eigen values of a matrix by Power method.

UNIT II **10 Hours**

INTERPOLATION, DIFFERENTIATIONAND INTEGRATION

Interpolation: Newton's forward and backward interpolation formulae - Numerical differentiation: Newton's forward and backward interpolation formulae. Numerical integration: Trapezoidal rule- Simpson's rules for single integrals- Two point Gaussian quadrature formula.

UNIT III **14 Hours**

SOLUTIONS OF DIFFERENTIAL EQUATIONS

Solution of first order ordinary differential equations: Fourth order Runge- Kutta method - Solution of partial differential equations: Elliptic equations: Poisson's equation- Parabolic equations by Crank Nicholson method- Hyperbolic equations by explicit finite difference method.

UNIT IV **12 Hours**

TESTING OF HYPOTHESIS

Sampling distributions- Large sample test: Tests for mean- Small sample tests: Tests for mean (t test), F- test- Chi-square test for Goodness of fit and Independence of attributes

UNIT V **12 Hours**

DESIGN OF EXPERIMENTS

Completely randomized design - Randomized block design - Latin square design.

FOR FURTHER READING

Collection of data and use the testing of hypothesis to analyze the characteristics of the data.

Total: 60 Hours

Reference(s)

1. Grewal B. S, Numerical Methods in Engineering and Science with Programms in C & C++, Ninth Edition, Khanna Publications, 2010.
2. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, PHI Learning Private Limited, New Delhi, 2009.
3. Gerald C. F and Wheatley P.O, Applied Numerical Analysis, Seventh Edition, Pearson Education, New Delhi, 2004.

4. Johnson R.A, Miller and Freund's Probability and Statistics for Engineers, Seventh Edition, Prentice Hall of India, New Delhi, 2005.
5. Walpole R.E, Myers R.H, Myers R.S.L and Ye K, Probability and Statistics for Engineers and Scientists, Seventh Edition, Pearsons Education, Delhi, 2002.
6. Burden R. L and Douglas Faires J, Numerical Analysis Theory and Applications, CengageLearning, Ninth Edition, 2005.

16FD402 PRINCIPLES OF FOOD PROCESSING 3 2 0 4

Course Objectives

- Understand the principles of food processing and their impact on the shelf life and quality of food materials and products
- Learn various methods of food processing viz., drying, milling, freezing, thermal treatments etc.
- Introduce novel food processing techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Apply different methods of high and low temperature processing techniques over raw foods and analyze the process time of that food properties of food
2. Understand and apply the suitable dryers to different food to increase the shelf life and analyse the working of extrusion process and their features.
3. Analyze the shelf life of foods processed and preserved by natural and chemical agents.
4. Understand the operations and features of different non-thermal processing techniques and applying to improve the shelf life of product.
5. Apply the principle of advanced novel techniques in food processing industries.

Articulation Matrix

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

UNIT I **16 Hours**

HIGH AND LOW TEMPERATURE PROCESSING OF FOODS

Methods of applying heat to food - Blanching, Pasteurization, Sterilization - thermo bacteriology, commercial sterility, calculation of process time - methods of sterilization - equipment. Methods of low temperature preservation - Chilling, Freezing, freeze drying and freeze concentration - theory and principles.

UNIT II **15 Hours**

DRYING, DEHYDRATION AND EXTRUSION

Drying - types of dryers. Dehydration-Osmotic dehydration-theory and principles. Water activity - sorption behaviour of foods - water activity and food stability - Relationship between water activity and moisture - Equilibrium moisture content. Extrusion cooking - principles and types of extruders - single and double screw extruder- construction and working. Effect of different parameters - quality of the extruded products.

UNIT III **15 Hours**

PROCESSING AND PRESERVATION OF FOODS BY CHEMICALS

Food preservation by sugar, salt, acid - Principles - mechanism- antimicrobial activity. Preservation by chemicals- type of chemical preservatives- sulphur dioxide, benzoic acid, etc; use of other chemicals like acidulants, antioxidants, mold inhibitors, antibodies, etc. Factors affecting antimicrobial activity of preservatives.

UNIT IV **13 Hours**

NON THERMAL PROCESSING

Food Irradiation - High Pressure Processing- Pulsed electric field processing, pulsed light treatment and Ultrasound - Theory and Principles - effect on microorganisms- Application in Processing of foods.

UNIT V **16 Hours**

NOVEL METHODS OF FOOD PROCESSING

UV treatment, Ozone treatment, dielectric heating- microwave, radio frequency, ohmic and infrared heating theory, equipment, applications and effect on foods. Hurdle technology and Nano-technology - principle - application in food processing.

FOR FURTHER READING

Electrical resistance heating of foods - Electrically Processed Foods. Effect of heat and ultrasound on microorganisms and enzymes. Oscillating magnetic fields in Food Preservation.

Total: 75 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Da-Wen Sun, Emerging Technologies for food processing, 2nd Edition, Academic Press, 2014.
3. R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York, 1989.
4. Dennis R. Heldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.
5. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M.Balasubramaniam, C. Patrick Dunne, Daniel F.Farkas and James T.C.Yuan. Nonthermal processing Technologies for food, IFT Press, 2011.
6. G.W. Gould. New methods of Food Preservation, Springer, Boston, MA, 1995.

16FD403 INSTRUMENTATION AND PROCESS CONTROL IN FOOD INDUSTRY **3 0 0 3**

Course Objectives

- Provide fundamental knowledge on instruments and their applications in food processing
- Understand the function of instruments in food product development

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Recall the parts of instrumentation and their working in food industry
2. Analyze the basic principles of sensors and their applications.
3. Analyze the Modeling of physical process, controller characteristics, selection of controller mode and control schemes
4. Examine the concepts of system representation, time and frequency responses of systems
5. Design and develop instruments for food product development

Articulation Matrix

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

UNIT I **9 Hours**

SENSORS AND TRANSDUCERS

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

UNIT II **10 Hours**

FLOW AND TEMPERATURE MEASUREMEMNTS

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

UNIT III **9 Hours**

PROCESS MODEL AND CONTROLLER

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

UNIT IV **10 Hours**

TIME AND FREQUENCY RESPONSE ANALYSIS

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

UNIT V **7 Hours**

INSTRUMENTATION AND SENSORS FOR THE FOOD INDUSTRY

Optical Inspection Systems: Computer Vision system, Colour sorter. Food compositional analysis using NIR and FTNIR. Principles of measurement - Calibrations application in food industry. Practical considerations for implementing online measurements. Radiation thermometers: Principles of measurements and applications. Introduction to automation in food processing. Biosensors - equipments - e nose, NIR.

Total: 45 Hours

Reference(s)

1. Erika Kress-Rogers and Christopher J. B. Brimelow, Instrumentation and sensors for the food industry, Wood head publishing, 2001.
2. D. Patranabis, Sensors and Transducers, Prentice Hall India Pvt. Ltd, 2007.
3. E. O. Doeblin, Measurement Systems: Applications and Design, Tata McGraw-Hill Book Co., 2008.
4. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 2011.
5. Donald P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 2006.
6. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 30th reprint 2008.

16FD404 HEAT AND MASS TRANSFER 3 2 0 4

Course Objectives

- To impart the knowledge of conduction heat transfer mechanisms.
- To provide the knowledge on the principles of free and forced convection.
- To impart the knowledge on black body radiation and grey body radiation.
- To study the performance of various types of heat exchangers.
- To learn about diffusion mass transfer.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the Conduction mode of heat transfer in simple and composite systems.
2. Determine the parameters associated with free and forced convection.
3. Calculate the radiation heat transfer in black and grey bodies.
4. Compare the performance of various types of heat exchangers.
5. Understand the concept of diffusion mass transfer.

Articulation Matrix

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

UNIT I **16 Hours**

CONDUCTION

Introduction to unsteady state heat transfer by conduction and transient flow. Basic transfer processes - heat, mass and momentum - heat transfer process - conductors and insulators - Steady state heat -

conduction - Fourier's law of heat conduction - thermal conductivity and thermal resistance - linear heat flow - heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and spheres - extended surfaces (fins).

UNIT II **14 Hours**

CONVECTION

Newton law of cooling - film coefficient of heat transfer - convection - Forced convection- external flow, flow over plates, cylinders, bank of tubes, internal flow- Free convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer - overall heat transfer coefficient.

UNIT III **16 Hours**

RADIATION

Radiation heat transfer - concept of black and grey body - monochromatic total emissive power - Kirchoff's law - Planck's law - Stefan-Boltzman's law - Black body radiation- Grey body radiation - Shape factor.

UNIT IV **14 Hours**

HEAT EXCHANGERS

Heat exchangers - Logarithmic Mean Temperature Difference (LMTD) - Classification - overall coefficient of heat transfer - tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger - applications of heat exchangers, NTU - Effectiveness - NTU methods.

UNIT V **15 Hours**

MASS TRANSFER

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. Concept of mass transfer coefficients, Interphase mass transfer and over all mass transfer coefficients in binary systems.

FOR FURTHER READING

Application of Heat and mass transfer in food processing operations. Heat exchangers for solid, liquid and semi-solid foods.

Total: 75 Hours

Reference(s)

1. R. C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age International private limited, New Delhi, 2010.
2. Yunus A.Cengel, Heat and Mass Transfer: a Practical Approach, Tata McGraw Hill publishing Company private limited, New Delhi, 2007.
3. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 2009.
4. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, 2014.
5. Frank P. Incropera, Fundamentals of Heat and Mass Transfer, John Wiley, New Delhi, 2007.
6. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2009.

16FD405 COMPUTER APPLICATION IN FOOD INDUSTRY **3 0 0 3**

Course Objectives

- Provide basic information on computer skills and programming language.
- Impart knowledge related to the applications of computation in food industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyze the application of software and hardware in Food Technology
2. Programs using C++ features such as Objects, Class and constructors
3. Develop programs using arrays, inheritance and overloading
4. Develop solutions to problems on mathematical programming of unit operations involved food processing.
5. Demonstrate application of computers in controlling food machinery, inventory, processes etc.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Computerization-Importance of Computerization in food industry and IT applications in food industries- Introduction to Software & Programming Languages- Properties, Differences of an Algorithm and Flowcharts, Advantages and disadvantages of Flowcharts & Algorithms -Hardware used in food industry -Touch Screens- Hand Held Devices-Barcode Printers and Scanners-RFID Tags

UNIT II **9 Hours**

BASICS OF C

Introduction, characteristics of object oriented programming -Basic program construction - cout - cin - Data types - Variables - constants - operators - control statements - Class - Constructor - Destructor.

UNIT III **9 Hours**

ARRAYS AND INHERITANCE

Array Fundamentals - Arrays as Class Member Data - Arrays of Objects - String Manipulations - Inheritance- Public and Private Inheritance - Types of Inheritance-Single, Multi-Level, Multiple, Hierarchical- Polymorphism-Operator overloading-Function overloading.

UNIT IV **9 Hours**

APPLICATIONS OF MS EXCEL IN FOOD TECHNOLOGY

MS Excel Basics- Introduction to different menus and commands commonly used in solving problems- Introduction to a Barcharts and Piecharts- the procedure to develop a barcharts and piecharts on given Data- Application of MS Excel to solve the problems of Food Technology- Chemical kinetics in food processing

UNIT V **9 Hours**

APPLICATION OF COMPUTER IN FOOD INDUSTRY

Software for their application in food technology-Food Service software Descriptions- Familiarization with the application of computer in food Industries-Case study- milk plant-Management Information System-Important feature of the software- Each stage computerization-Implementation Plan -bakery-Inventory control-Flow chart of Production.

FOR FURTHER READING

Application of computer to solve the problems related to, Microbial distraction in thermal processing of food, Sensory evaluation of food, Statistical Quality Control.

Total: 45 Hours

16FD406 REFRIGERATION AND AIR CONDITIONING FOR FOOD PROCESSING

3 0 0 3

Course Objectives

- Learn the principles and the components involved in domestic and commercial refrigeration systems
- Understand the principles of air conditioning process
- Impart knowledge on application of Refrigeration & Air conditioning systems in food industries

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Select appropriate components of the refrigeration unit and analyze the effect of different refrigerants on environment.
2. Differentiate various refrigeration cycles and its applicability
3. Apply knowledge of psychrometry for air conditioning & various food processing operations.
4. Apply the knowledge of refrigeration and air conditioning in persevering foods using domestic and industrial refrigeration systems
5. Design refrigeration systems for food materials and choose appropriate refrigerated transport facilities

Articulation Matrix

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

UNIT I **10 Hours**

REFRIGERATION PRINCIPLES AND COMPONENTS

Refrigeration-principles - refrigeration effect-coefficient of performance-units of refrigeration - Refrigeration components-compressor-classification-principle and working- condensers-types-construction, principle and working. Evaporators-types-principle and working. Expansion device-types construction, principle and working. Refrigerants-properties-classification comparison and advantages-chloroform carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants

UNIT II **9 Hours**

VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE

Simple vapour compression cycle- T-S diagram - p-h chart- vapour compression system-different types- vapour absorption cycle - simple and practical vapour absorption system- advantages- ideal vapour absorption system- Electrolux refrigerator-Lithium bromide refrigeration-construction and principles

UNIT III **9 Hours**

PSYCHROMETRY

Psychrometry-terms-psychrometric chart- sensible heating- sensible cooling process -by-pass factor-humidification- dehumidification-sensible heat factor- evaporative cooling-cooling and dehumidification- cooling and humidification process-heating and dehumidification - heating and humidification- adiabatic mixing of air streams

UNIT IV **9 Hours**

AIR CONDITIONING SYSTEM

Air conditioning systems- equipments used-classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system- unitary and central air conditioning

system- application of refrigeration and air conditioning-domestic refrigerator and freezer-refrigerated trucks- ice manufacture- cold storage-freeze drying

UNIT V **8 Hours**

APPLICATIONS OF REFRIGERATION IN FOOD PROCESSING AND PRESERVATION

Cold storage for milk, meat, fruits, vegetables, poultry and marine products. Refrigerated Transport, Handling and Distribution, Cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display. Design considerations of cold storage

FOR FURTHER READING

Eco friendly refrigerants, types of compressors and its selection, Industrial and domestic refrigerants

Total: 45 Hours

Reference(s)

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2002
2. R.S. Khurmi and J. K. Gupta, A text book of Refrigeration and Air Conditioning, Eurasia Publishing housing (P) Ltd, New Delhi, 2002
3. Manohar Prasad, Refrigeration and Air conditioning, New Age International (P) Ltd, New Delhi, 1999
4. W. F. Stoecker, and J. W. Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1986
5. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th edition, 2001
6. S. C. Arora and S. Domkundwar, A course in Refrigeration and Air conditioning, DhanpatRai (P) Ltd., New Delhi, 1997

16FD407 HEAT AND MASS TRANSFER LAB 0 0 2 1

Course Objectives

- To impart the knowledge on conduction heat transfer
- To provide the knowledge on performance of heat exchangers.
- To demonstrate the principles of free and forced convection.
- To provide knowledge on black body radiation and grey body radiation.
- To study the concepts and to differentiate between heat and mass transfer.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Determine the thermal conductivity of composite wall and insulating materials.
2. Understand the performance of various types of heat exchangers.
3. Calculate the parameters associated with free and forced convection.
4. Determine the Stefan Boltzmann constant and emissivity of a radiating body.
5. Understand about diffusion mass transfer.

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Determination of thermal conductivity in a composite wall

2 **2 Hours**

EXPERIMENT 2

Determination of thermal conductivity by lagged pipe method

3 **4 Hours**

EXPERIMENT 3

Determination of heat transfer coefficient in a parallel flow heat exchangers

4 **2 Hours**

EXPERIMENT 4

Determination of heat transfer coefficient in a counter flow heat exchangers

5 **4 Hours**

EXPERIMENT 5

Determination of heat transfer coefficient in free convection

6 **4 Hours**

EXPERIMENT 6

Determination of emissivity of the given test surface

7 **2 Hours**

EXPERIMENT 7

Determination of Stefan-Boltzmann's constant in radiation heat transfer

8 **2 Hours**

EXPERIMENT 8

Determination of effectiveness of heat transfer in a coiled type heat exchanger

9 **4 Hours**

EXPERIMENT 9

Experiment on diffusion

10 **4 Hours**

EXPERIMENT 10

Mass transfer with or without chemical reaction

Total: 30 Hours

16FD408 PRINCIPLES OF FOOD PROCESSING LAB 0 0 2 1

Course Objectives

- Understand the basic principles involved in food process engineering
- Apply the concept of mass and energy balances during processing of food
- Perform calculations on unit operations involved in food Processing

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Analyse the important quality characteristics of both solid and liquid foods
2. Assess the moisture content and drying rate for both porous and non-porous food materials
3. Evaluate the efficiency of different types dryers for the food materials
4. Analyze the changes occur during thermal processing of foods
5. Assess the microbial quality of foods by applying novel processing methods

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1
Determination of textural characteristics of foods

2 **4 Hours**

EXPERIMENT 2
Determination of flow behavior of Newtonian and Non-Newtonian fluids

3 **4 Hours**

EXPERIMENT 3
Determination of Thermal Death Time

4 **2 Hours**

EXPERIMENT 4
Determination of Water activity of processed food products

5 **2 Hours**

EXPERIMENT 5
Determination of drying rate of fruits and vegetables in Tray dryer

6 **2 Hours**

EXPERIMENT 6

Determination of colour characteristics of curry leaves during Fluidized bed dryer

7 **4 Hours**

EXPERIMENT 7

Determination of textural characteristics by Extrusion cooking

8 **2 Hours**

EXPERIMENT 8

Retention of ascorbic acid during Microwave drying of leafy vegetable

9 **2 Hours**

EXPERIMENT 9

Dehydration and rehydration of vegetables in rotary dryer

10 **2 Hours**

EXPERIMENT 10

Determination of freezing point of food materials

11 **2 Hours**

EXPERIMENT 11

Effect of UV treatment on microbial quality of liquid foods

12 **2 Hours**

EXPERIMENT 12

Effect of ohmic heating on microbial quality of liquid foods

13 **0 Hours**

EXPERIMENT 13

Visit to food processing industries/ pilot plant

Total: 30 Hours

16FD409 MINI PROJECT II 0 0 2 1

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Articulation Matrix

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

Total: 30 Hours

3 0 0 3

16FD501 BAKING AND CONFECTIONERY TECHNOLOGY

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce baking techniques to produce bread, biscuits and cakes
- Familiarize with standards and regulations applied in food industry

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Apply the principles of baking and analyze the role of ingredients in baking
2. Compare the processing method for the production of biscuits and cookies
3. Apply the production process for different types of confectionery products
4. Illustrate and analyze the processing parameters of baking machineries
5. Assess the standards and quality control for bakery and confectionery products

Articulation Matrix

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

UNIT I **9 Hours**

BAKING PRINCIPLES AND BREAD

Introduction to wheat- Structure, types, quality evaluation. Dough rheology. Baking principles, Bread- role of ingredients and its chemistry, additives, varieties of bread. Methods of bread preparation- advantages and disadvantages, bread spoilage and remedies. Cake- types of cakes, role of ingredients, cake mixing methods, Preparation, faults and remedies.

UNIT II **9 Hours**

BISCUIT AND COOKIES

Biscuits and cookies - role of ingredients. Types of biscuit dough - Developed/ Hard dough- semi-sweet, fermented and puff; Soft dough, short dough biscuits. Classification and Production of biscuits and cookies. Quality tests for biscuits and cookies. Faults and remedies.

UNIT III **12 Hours**

CONFECTIONERY PRODUCTS

Introduction - Role of ingredients and additives used in confectionery. Cocoa products and its uses in confectionery. Stages of Sugar cookery. Types of confectionery products and manufacturing process - chocolate, caramels, toffees, fondants, fudges and flour confectionery.

UNIT IV **9 Hours**

BAKERY EQUIPMENTS

Equipments and machineries for a bakery unit - Light Equipments, Heavy/ Bulk handling Equipments - Dough mixers, Dividers, rounding, sheeting and laminating machines. Ovens and Slicers. Packaging equipment.

UNIT V **6 Hours**

PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT

Packaging requirements and materials. FSSAI Standards and regulations for bakery and confectionery products. Quality control and Good Manufacturing Practices (GMP). Layout for Baking and Confectionery plant.

FOR FURTHER READINGS

Millet based biscuit and cookies, Eggless cake, different types of bakery oven, different types of dough kneaders.

Total: 45 Hours

Text Book(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, 1998.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Pomeranz. Y. Modern Cereal Science and Technology, MVCH Publications, New York, 1987.
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007
5. Samuel A. Matz., Equipment for Bakers, Pan Tech International Publication, 1988.

Reference(s)

1. Baker's Handbook on Practical Baking, US Wheat Associates, New Delhi, 1994.

16FD502 MEAT, POULTRY AND FISH PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- Impart the processing technologies and equipment used for meat, fish and Poultry
- Understand the preservation and value addition of meat, egg and poultry products
- Assess the quality assurance, sanitation and Packing techniques for meat,fish and Poultry products

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyze the scope, challenges, nutritive value and processing techniques of meat and its products
2. Assess the nutritive value, processing and quality parameters of Poultry, egg and its products
3. Apply the appropriate processing and preservation methods for fish and its products
4. Evaluate the quality and suitable packaging for meat, fish and poultry products
5. Apply the effective processing methods for waste/By-product utilization from meat and poultry industry

Articulation Matrix

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

UNIT I **12 Hours**

MEAT PROCESSING

Meat processing industries- status and scope- Structure, composition and nutritive value of meat, Common and commercially important meats, pre -slaughter care-stunning methods-slaughtering method- evisceration and dressing of carcasses-refrigeration and transport, Meat tenderization and Meat quality evaluation. Rigor mortis - changes of meat, carcass chilling, ageing; storage of fresh meat. Processing and preservation of meat- aging, pickling, smoking. Dried and Cured meat. Canned meat, frozen meat, Cooked and Refrigerated meat, Sausages.

UNIT II **12 Hours**

POULTRY AND EGG PROCESSING

Composition and nutritive value of poultry meat, Types of poultry, production, classification & grading. Slaughtering, bleeding, scalding, defeathering, evisceration, chilling, packaging; storage. Egg structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing. Egg quality assessment

UNIT III **9 Hours**

FISH AND FISH PROCESSING

Fish-composition and nutrition value, commercially important fish and shell fish, Processing and Preservation-chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils; ready-to-eat fish and other sea food products, spoilage factors, ship board operations, storage and transport.

UNIT IV **5 Hours**

PACKAGING AND QUALITY STANDARDS

Modified atmosphere packaging, packaging of retail cuts, Indian regulation and quality standards, Kosher and Halal certification, HACCP, Good Manufacturing Practices, meat plant sanitation and safety.

UNIT V **7 Hours**

EQUIPMENTS AND BY-PRODUCT UTILIZATION

Meat processing equipment - Meat grinder, Sausage stuffer, Hand crank meat tenderizer, meat mixer, meat mincer and meat slicer. Poultry processing equipment - Chicken feather plucking machine, cutter, Slaughter machine, Bone and meat cutter. Fish processing equipment - Fish slicing machine, Fish gutting machine, fish grader, fish de-scaling machine, Solid waste, Liquid waste, Chicken rendering unit-Dry rendering, wet rendering, Effluent Treatment Plant, By product utilization.

FOR FURTHER READING

Non destruction quality assessment of egg, meat and poultry carcasses, Differences between country and leghorn eggs, carcasses.

Total: 45 Hours

Reference(s)

1. A.M Pearson and T.A. Gillett, Processed Meats, CBS Publishers & Distributors, Third Edition, New Delhi, 1997.
2. P.C. Panda, Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.
3. K.K. Balachandran, Post harvest Technology of fish and fish products, Dayapubliching house, Delhi, 2001.
4. G.M. Hall, Fish processing Technology, Blackie Academic and Professional, London, 1997.
5. W.J. Stadelman and O. J. Cotterill, Egg science and Technology, AVI Publishing Co., Connecticut, 1995.
6. V.P. Singh and NeelamSachan, Principles of meat technology, New India publishing agency, New Delhi, 2012.

16FD503 DESIGN OF FOOD PROCESSING EQUIPMENT

3 2 0 4

Course Objectives

- Impart knowledge on basic principles of designing equipment for food processing
- Become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, driers etc.
- Provide an idea about devising cold storage units, freezers etc.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Analyze the process parameters of equipment and design pressure vessels, storage tanks and pulper.
2. Select the suitable products and materials for designing heat exchangers and evaporator.
3. Design and analyze the performance of dryers and extruders.
4. Estimate the cooling load of cold storage and design a cold storage for fruits and vegetables.
5. Analyze and determine the parameter for designing size reduction and conveying equipment.

Articulation Matrix

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

UNIT I **15 Hours**

DESIGN OF PRESSURE VESSELS, STORAGE TANKS AND PULPER

Introduction to design - principles and selection of food processing equipment - design of pressure vessels - design aspects of storage tanks, design of sterilizers and process vats - design of pulper - design considerations - materials of construction - installation and operation.

UNIT II **15 Hours**

DESIGN OF HEAT EXCHANGERS AND EVAPORATORS

Design of heat exchangers - plate heat exchanger, shell and tube heat exchangers - materials of construction - installation and operation - design of single effect evaporators - applications -multiple effect evaporators- entrainment separators-installation and maintenance.

UNIT III **15 Hours**

DESIGN OF DRYERS AND EXTRUDERS

Design of dryers - cabinet dryer, fluidized bed dryer, heat pump dryer, foam mat dryer - freeze dryer - Spray dryer - design considerations, installation, operation and maintenance - design considerations of

food extruders - single and twin screw extruders - installation, operation and maintenance of food extruders.

UNIT IV **15 Hours**

DESIGN OF COLD STORAGE AND FREEZERS

Design of cold storage - estimation of cooling load - construction, operation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables - design of freezers - types of freezers - design considerations - construction and operation-design of frozen storage.

UNIT V **15 Hours**

DESIGN OF SIZE REDUCTION AND CONVEYING EQUIPMENTS

Design consideration of size reduction equipments- installation and maintenance-design consideration of material conveying equipments- belt conveyor- screw conveyor - bucket elevator- pneumatic conveyor.

FOR FURTHER READING

Factor of safety, Poisson's ratio, Food grade stainless steel, hygienic design of equipments, hygienic practices during maintenance operation.

Total: 75 Hours

Reference(s)

1. P.S. Phirke, Processing and conveying equipment design, Jain Brothers, New Delhi, 2004.
2. M.V. Joshi and V.V. Mahajani, Process Equipment Design (3rd edition), New India Publishing Agency, New Delhi, 2004.
3. K.M. Sahay and K.K. Singh, Unit operations of Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
4. Jasim Ahmed and Mohammad Shafiur Rahman (Editors), Handbook of Food Process Design, John Wiley and Sons, Ltd., U.K., 2012.
5. Kennath. J. Valentas and R.Paul Singh (Editors), Handbook of Food Engineering Practice, CRC Press, London, 1997.
6. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A, 2003.

16FD504 CHEMISTRY OF FOOD PROCESSING 3 0 0 3

Course Objectives

- To impart knowledge on Importance of nutrition
- Understand the chemical changes of carbohydrates, proteins, fats and oils and micro nutrients during processing of foods
- To acquire knowledge about food additives and preservatives

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

Course Outcomes (COs)

1. Analyze the recommended dietary allowances and balanced diet
2. Exemplify the changes in proteins and carbohydrates on processing of foods
3. Explain the chemical aspects of fats and oils and its safety uses
4. Recognize the effect of processing on retention of flavors, pigments, vitamins and minerals
5. Apply the concept and analyze the requirement of food additives and preservatives in food processing and preservation

Articulation Matrix

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

UNIT I **9 Hours**

IMPORTANCE OF NUTRITION

Concepts and content of nutrition: Nutrition agencies; Nutritional policies and their implementation. Formulation of diets: Classification of balanced diet; Preparation of balanced diet for various groups; Diets and disorders. Recommended dietary allowances; For various age group; According to physiological status; Athletic and sports man; Geriatric persons; Malnutrition

UNIT II **9 Hours**

FOOD CHEMISTRY OF PROTEIN AND CARBOHYDRATES

Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates; Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic modification of protein

UNIT III **9 Hours**

FOOD CHEMISTRY OF FATS AND OILS

Lipids in foods: Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil; Oil processing: Refining, hydrogenations, inter esterification, safety use of oils and fats in food formulation; Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques chemical aspects of lipids, antioxidants.

UNIT IV **9 Hours**

FOOD CHEMISTRY OF MICRONUTRIENTS

Food Flavour - sensory assessment, technology for flavour retention; Pigments: effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs Food colorants; Regulatory use of regulatory dyes; Colour losses during thermal processing; vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins and minerals, optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors.

UNIT V **9 Hours**

FOOD ADDITIVES AND PRESERVATIVES

Food Additives: introduction-classification; Food preservatives - classes, antioxidants and chelating agents. Acidulants, Thickeners, emulsifiers, sweeteners, bleaching and maturing agents, anti-caking agents, humectants, flavor enhancer, clarifying agents, antifoaming agents, and fat replacers. E numbers, Committees regulating Food additives, toxicological studies and safety evaluation

FOR FURTHER READING

Industrial applications of carbohydrates- Resistant starch- modification of proteins- storage and stability of proteins.

Total: 45 Hours

Reference(s)

1. S. Sadasivam and A. Manickam, Biochemical Methods, New Age Internationals, New Delhi, 1996
2. Belitz and W. Grosch, Food chemistry, Springer Verley Berlin Heidelberg, New York, 1986
3. David and S. Robinson, Food biochemistry and Nutritive Value, Longman Group, U.K, 1987
4. Leslie Hart F. and Harry Johnstone Fisher, Modern Food Analysis, Spinger - Verlag, New York, 1971
5. D.L. Nelson and Cox M. M. Lehninger, Principles of Biochemistry Third (Indian) edition Macmillian, Worth Publishers, 1996
6. E.E. Conn and P.K. Stumpf, Outlines of Biochemistry, Wiley Eastern Ltd., Fifth Edition. 2000

16FD507 CHEMISTRY OF FOOD PROCESSING LABORATORY

0 0 2 1

Course Objectives

- To familiarize the students on estimation of food composition by different methods
- To understand physicochemical properties of food components
- To analyze the changes in composition of foods with respect to carbohydrates, lipids, protein and water on processing.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the various experimental procedures for different food constituents
2. Explain the quality of food
3. Analyze the changes in food composition during processing and storage
4. Implement the process protocol for quality food production
5. Evaluate and generate food formulation with longer shelf life

Articulation Matrix

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

1 **4 Hours**

EXPERIMENT 1

Estimation of pH and Titratable acidity

2 **4 Hours**

EXPERIMENT 2

Estimation of protein from milk and egg by colorimetric methods.

3 **4 Hours**

EXPERIMENT 3

Estimation of total sugars by titrimetric method.

4 **4 Hours**

EXPERIMENT 4

Estimation of starch by (a) titrimetric method (b) calorimetric method.

5 **4 Hours**

EXPERIMENT 5

Estimation of total polyphenols.

6 **4 Hours**

EXPERIMENT 6

Determination of antioxidant activity.

7 **2 Hours**

EXPERIMENT 7

Estimation of total ash

8 **2 Hours**

EXPERIMENT 8

Assay of polyphenol oxidase.

9 **2 Hours**

EXPERIMENT 9

Estimation of crude fibre.

Total: 30 Hours

0 0 2 1

16FD508 BAKING AND CONFECTIONERY LABORATORY

Course Objectives

- Understand the basic terms and principles involved in baking
- Impart training on baking and confectionery methods
- Assess the role of ingredients in bakery and confectionery products

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Identify the ingredients and demonstrate the equipments and tools used for baking
2. Evaluate the dough characteristics for the preparation of bakery products
3. Analyse different types of bakery and confectionery products and their quality parameters
4. Assess the preparation of sugar confectionary products
5. Apply baking skills and understand the scope of baking industry

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Estimation of gluten content in wheat and refined flour

2 **2 Hours**

EXPERIMENT 2

Quality analysis of wheat and maida flour

3 **2 Hours**

EXPERIMENT 3

Determination of protein quality in wheat and maida flour

4 **2 Hours**

EXPERIMENT 4

Experiment on the preparation of Cookies

5 **2 Hours**

EXPERIMENT 5

Experiment on the preparation of Muffins

6 **2 Hours**

EXPERIMENT 6

Determination of Dough characteristics using farinographic and extensographic

7 **2 Hours**

EXPERIMENT 7

Experiment on preparation of Bun and bread rolls

8 **2 Hours**

EXPERIMENT 8

Preparation and analysis of baking and quality parameters in plain and fancy cakes

9 **2 Hours**

EXPERIMENT 9

Identification of different stages of sugar boiled confectionery

10 **2 Hours**

EXPERIMENT 10

Experiment on preparation of Fudge

11 **2 Hours**

EXPERIMENT 11

Experiment on Preparation of Fondant

12 **2 Hours**

EXPERIMENT 12

Experiment on Preparation of Soft candy

13 **4 Hours**

EXPERIMENT 13

Experiment on preparation of Hard candy

14 **2 Hours**

EXPERIMENT 14

Preparation of fruit candies

15

EXPERIMENT 15

Visit to bakery / confectionery units

Total: 30 Hours

0 0 2 1

16FD509 TECHNICAL SEMINAR I

Course Objectives

- To develop the self-learning skills to utilize various technical resources available from multiple field.
- To promote the technical presentation and communication skills.
- To impart the knowledge on intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple fields
2. Improve the technical presentation and communication skills
3. Analyze the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds
4. Interact and share their technical knowledge to enhance the leadership skills
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

16FD510 MINI PROJECT III **0 0 2 1**

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

15GE601 PROFESSIONAL ETHICS 2 0 0 2

Course Objectives

- To understand Human values, ethical theory, codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural associated ethics and engineers responsibility

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Articulate engineering ethics theory with sustained lifelong learning to strengthen autonomous engineering decisions
2. Be an example of faith, character and high professional ethics, and cherish the workplace responsibilities, rights of others, public welfare, health and safety
3. Contribute to shape a better world by taking responsible and ethical actions to improve the environment and the lives of world community
4. Fortify the competency with facts and evidences to responsibly confront moral issues raised by technological activities, and serve in responsible positions of leadership
5. Be Proficient in analytical abilities for moral problem solving in engineering situations through exploration and assessment of ethical problems supported by established experiments

Articulation Matrix

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

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of 'Engineering Ethics'- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlberg's and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse - Sample codes NSPE - IEEE - Institution of Engineers (India).

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights.

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

FOR FURTHER READING

The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl case studies - Fundamental Rights, Responsibilities and Duties of Indian Citizens -Sample code of ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.

2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.
6. http://www.slideworld.org/slidestag.aspx/human-values-and- Professional-ethics

16FD602 WASTE MANAGEMENT IN FOOD INDUSTRIES

3 0 0 3

Course Objectives

- Understand the importance of treating waste product from food industry.
- Learn different solid and liquid management techniques
- Impart knowledge on different treatment methods and recycling of waste product from food industry

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyse the impacts of food wastage and its causes in environment
2. Assess and analyse the different food industry wastes leads to environmental pollution
3. Apply the physical, chemical and biological principles for liquid waste treatment
4. Analyse the solid waste management techniques
5. Evaluate the by-product/waste utilization from different food processing industries

Articulation Matrix

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

UNIT I **6 Hours**

INTRODUCTION TO WASTE MANAGEMENT

Definition-Food wastage- food loss- global scenario- Sources of waste and pollutants, Classification and characterization of wastes - causes and prevention of food waste- impact of food losses and waste- food waste hierarchy-need for minimization of food waste

UNIT II **9 Hours**

FOOD INDUSTRY WASTES AND ENVIRONMENTAL POLLUTION

Food Industries- Environmental Pollution due to Food Industry wastes - characteristics and impact on soil, water, air pollution - Processes for waste utilization from fruit and vegetable industries, meat, fish, dairy, oil processing industries.

UNIT III **12 Hours**

LIQUID WASTE MANAGEMENT IN FOOD INDUSTRIES

Principles of Physical treatment - Screening, Sedimentation, Filtration, back washing, membrane separation. Principles of Chemical treatment- COD, BOD, VLSS, MLSS and ETP. Coagulation, flocculation, Precipitation, flotation, Disinfection and fluoridation. Principles of biological treatment, aerobic process, activated sludge process, trickling filters, anaerobic digestion, UASB reactor.

UNIT IV **6 Hours**

SOLID WASTE MANAGEMENT IN FOOD INDUSTRIES

Solid waste management techniques, Principles and practices, 3R concept, resource recovery. Composting methods of composting, vermicomposting- Incineration, pyrolysis- Briquetting - value addition, Pelletizing, SCP, enzymes, pectin.

UNIT V **12 Hours**

BY PRODUCT/WASTE UTILIZATION

Utilization of oil cake and defatted oil cake as cattle feed and industrial uses. Utilization of sugarcane tops, bagasse, molasses and press mud - animal feed from sugarcane tops and bagasse - Utilization of agro-industries - Utilization of furfural and activated carbon-Environmental Laws and Acts-Regulatory issues with food industry waste

FOR FURTHER READING

Pollution control board, BOD, COD of water, Threshold level of solids present in water, Air pollution, mitigation measures for solid, liquid and air pollution. Case Studies and regulations on waste management.

Total: 45 Hours

Reference(s)

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 2008.
2. Wang, L. K., Lo, H. H., Hung, Y. T., & Yapijakis, C. Waste treatment in the food processing industry, CRC Press,2005
3. Lawrence K.Wang, Yung-Tse Hung, Howard H.Lo and Constantine Yapijakis, Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006.
4. Waldron, K. W, Handbook of waste management and co-product recovery in food processing, Elsevier,2009
5. Sylvan H Wittwer, Food, Climate and Carbon Dioxide: The Global Environment and World Food Production, CRC Press, 1995.
6. S.N. Jogdhand, Environmental Biotechnology: Industrial Pollution Management, (III ed), Himalaya Publishing House, New Delhi, 2010.

16FD603 DAIRY TECHNOLOGY 3 0 0 3

Course Objectives

- Analyse the physico-chemical and functional properties of milk constituents
- Understand the steps involved in the processing of milk and milk products
- Apply the technologies for the production of different dairy products

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Understand the composition of milk and physical and chemical properties of milk
2. Apply the principles of different thermal processing of milk
3. Apply the principles and process of Homogenization and cream separation in milk processing
4. Analyse the process flow for the preparation of different dairy products
5. Analyse the process and equipments used for the manufacturing of ice-cream and milk powder production

Articulation Matrix

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

UNIT I **9 Hours**

MILK PROPERTIES AND PRESERVATION

Milk- Composition and Nutritional value- physico chemical properties, Macro components - Micro components. Milk reception- Platform test - Cooling and storage of raw milk -principles and methods transfer of milk -transport and storage tanks - Standardization-cleaning and sanitization of Dairy equipment- CIP systems - Can washers - types - working principle and maintenance.

UNIT II **9 Hours**

PASTEURIZATION AND FILLING OF MILK

Pasteurization - principles and objectives - methods- batch / LTLT method - equipments - HTST method - process and equipments- plate heat exchanger - regeneration efficiency - milk flow diagram - UHT pasteurization- principles and methods - vacreation - form fill seal machines- aseptic filling.

UNIT III **9 Hours**

HOMOGENIZATION AND CREAM SEPARATION

Homogenization - theory - effect on milk properties - working principle of homogenizers - valves - pumps-homogenization efficiency - cream separation - principles - gravity and centrifugal separation - clarifiers and separators - centrifugal separator- parts -construction and working principle - separation efficiency - fat loss in skim milk - bactofugation.

UNIT IV **9 Hours**

BUTTER AND CHEESE PROCESSING

Butter - composition- method of manufacture- churning of cream - theory of churning - operation of butter churn- over run -batch and continuous methods of butter making- cheese - composition classification - cheddar and cottage cheese - equipments- cheese vats and press- construction details.

UNIT V **9 Hours**

ICE CREAM AND MILK POWDER PRODUCTION

Ice cream - ingredients - preparation of ice cream mix - overrun- freezing - calculation of freezing point and refrigeration requirements of mixes- ice cream freezers -batch and continuous freezers - drying of milk - drying equipments - drum drier and spray drier - components - construction and working principles.

FOR FURTHER READING

Introduction to traditional milk products. Types of milk (Standardized milk, toned milk and double toned milk, etc), waste management in dairy industry

Total: 45 Hours

Reference(s)

1. De Sukumar Outlines of Dairy Technology, Oxford University press, New Delhi, 2002.
2. R.K. Robinson, Modern dairy technology Vol. I Advances in Milk processing. Elsevier Applied Science Publishes, London, 1986.
3. Gerrit Smit, Dairy processing Improving quality, Published by Woodhead Publishing Limited, CCR PRESS, 2000.
4. H.G. Kessler, Food engineering and dairy technology, Verlag A. Kessler, Freising, (F.R.Germany.) 1981.
5. A.W. Farrall, Engineering for dairy and food products, John Wiley and Sons, New York, 1963.

16FD604 FRUITS AND VEGETABLE PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- Recognize the role of fruits and vegetables in human nutrition and diet
- Gain knowledge on chemical composition of fruits and vegetables and the effect of processing on nutrients and pigments
- Learn the methods of fruit and vegetable processing and preservation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Implement low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Produce value added products from fruits and vegetables by using suitable preservation method (sugar, salt or dehydration)
3. Produce dehydrated fruits and vegetables
4. Apply minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Plan to produce canned and bottled fruits and vegetables

Articulation Matrix

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

UNIT I **9 Hours**

HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES

Fruits and vegetables: classification, nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - precooling and storage - Storage under ambient condition, low temperature storage - chilling, frozen storage- chilling injury, freeze burn. Controlled atmosphere storage, Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

UNIT II **9 Hours**

PRESERVATION OF FRUITS AND VEGETABLES BY VALUE ADDITION

Methods of fruit and vegetable preservation - Processing using sugar- Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated, fruit beverages. Processing using salt - Brining - Preparation of pickles, chutney and sauces, ketchup. Machinery involved in processing of fruits and vegetables products

UNIT III **9 Hours**

PRESERVATION BY DRYING AND DEHYDRATION

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

UNIT IV **9 Hours**

MINIMAL PROCESSING AND FERMENTATION

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal Processing of Fruits and Vegetables. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

UNIT V **9 Hours**

CANNING AND BOTTLING

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

FOR FURTHER READING

Toping of sugar/salt, Hybrid drier, safe level of irradiation, solid state fermentation, layout of fruit/vegetable canning unit

Total: 45 Hours

Text Book(s)

1. Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.
2. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
3. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.

Reference(s)

1. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
2. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
3. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.

16FD607 DAIRY TECHNOLOGY LABORATORY 0 0 2 1

Course Objectives

- Understand physico-chemical and colloidal properties of milk
- Assess the quality of raw milk and their implications on safety standards of milk and milk products
- Apply the unit operations in milk processing: separation, standardization, homogenization, pasteurization methods, spray drying

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyse the presence of macro components in milk and detect the adulterants in milk
2. Find the pasteurization efficiency of milk using different methods of pasteurization.
3. Demonstrate the construction details and milk flow pattern of plate heat exchanger
4. Evaluate the efficiency of various equipment for the processing of milk
5. Determine the drying efficiency of different dryers for the production of milk powder

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1

Estimation of specific gravity of milk

2 **2 Hours**

EXPERIMENT 2

Determination of fat content of milk by Gerber’s method

3 **2 Hours**

EXPERIMENT 3

Standardization of milk by Pearson square method

4 **2 Hours**

EXPERIMENT 4

Study on (Low temperature low time) LTLT process vat

5 **2 Hours**

EXPERIMENT 5

Study on construction details and milk flow pattern in Plate heat exchanger.

6 **2 Hours**

EXPERIMENT 6

Construction of parts and working of cream separator

7 **2 Hours**

EXPERIMENT 7

Problem solving - Skimming efficiency of cream separator

8 **2 Hours**

EXPERIMENT 8

Construction and operation of butter churning and butter working accessories

9 **2 Hours**

EXPERIMENT 9

Construction and working of homogenizer for reduction of fat globules

10 **2 Hours**

EXPERIMENT 10

Construction and operation of Spray dryer for the production of milk powder

11 **2 Hours**

EXPERIMENT 11

Preparation of ice cream

12 **2 Hours**

EXPERIMENT 12

Problem solving- calculations for the preparation of Ice cream mix

13 **4 Hours**

EXPERIMENT 13

Detection of Adulteration of milk

14 **2 Hours**

EXPERIMENT 14

Quality analysis of raw milk

15 **0 Hours**

EXPERIMENT 15

Visit to Dairy processing industry

Total: 30 Hours

16FD608 FRUITS AND VEGETABLE PROCESSING TECHNOLOGY LABORATORY

0 0 2 1

Course Objectives

- Learn postharvest changes that occur in fruits and vegetables
- Demonstrate methods to prevent or reduce deterioration and loss of nutritional quality of vegetables and fruits
- Impart knowledge on fruits and vegetables preservation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Produce ready to serve beverages
2. Produce value added products like jam, jelly, ketchup, puree
3. Produce preserves and candy from fruits
4. Implement dehydration methods to produce dehydrated fruits and vegetables
5. Demonstrate the production of fermented products like pickles, sauerkraut from fruits and vegetables

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1
Preparation of Ready To Serve (RTS) beverages

2 **2 Hours**

EXPERIMENT 2
Preparation of plain/ mixed fruit jam

3 **2 Hours**

EXPERIMENT 3
Preparation of fruit jelly and orange marmalade

4 **2 Hours**

EXPERIMENT 4
Preparation of fruit preserve and candy

5 **2 Hours**

EXPERIMENT 5
Preparation of tomato puree and ketchup

6 **4 Hours**

EXPERIMENT 6
Preparation of pickles

7 **2 Hours**

EXPERIMENT 7
Minimal processing of fruits and vegetables

8 **2 Hours**

EXPERIMENT 8
Osmotic dehydration of fruits

9 **4 Hours**

EXPERIMENT 9
Osmotic dehydration of vegetables

10 **2 Hours**

EXPERIMENT 10
Dehydration of vegetables

11 **2 Hours**

EXPERIMENT 11
Sauerkraut fermentation

12 **2 Hours**

EXPERIMENT 12
Effect of blanching on enzymatic activity

13 **2 Hours**

EXPERIMENT 13

Determination of pectin content

14 **0 Hours**

EXPERIMENT 14

Visit to fruit processing industry

15 **0 Hours**

EXPERIMENT 15

Visit to fruit processing industry

Total: 30 Hours

Reference(s)

1. S. Ranganna, Hand Book of Analysis and Quality Control for Fruit and Vegetable products, second Edition, Tata McGrew Hill Publishing Company Pvt Ltd, 2008
2. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.

16FD609 TECHNICAL SEMINAR II 0 0 2 1

Course Objectives

- To develop the self-learning skills to utilize various technical resources available from multiple field.
- To promote the technical presentation and communication skills.
- To impart the knowledge on intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Refer and utilize various technical resources available from multiple fields
2. Improve the technical presentation and communication skills
3. Analyze the importance of intonation, word and sentence stress for improving communicative competence, identifying and overcoming problem sounds.
4. Interact and share their technical knowledge to enhance the leadership skills
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

16FD610 MINI PROJECT IV **0 0 2 1**

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	3	2	-	-	2	1	-	-	-	-	-
2	2	2	1	3	-	2	-	-	-	-	2	2
3	-	-	3	2	2	-	-	2	-	-	2	2
4	-	1	-	2	3	1	2	2	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	2
												Total: 30 Hours

15GE701 ENGINEERING ECONOMICS 3 0 0 3

Course Objectives

- To introduce the concepts of micro, macroeconomic systems and business decisions in organizations.
- To acquire knowledge on laws of demand & supply and methods of forecasting the demand
- To emphasis the systematic evaluation of the costs, breakeven point for return on economics and diseconomies
- To acquaint in pricing methods, payback and competition in modern market structure
- To obtain knowledge on macro economics, various taxes and financial accounting procedures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Explain the micro economic environment for creating a favourable business environment.
2. Make use of the major concepts and techniques of engineering economic analysis in real time applications.
3. Compare the cost of multiple projects by using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
4. Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.
5. Examine and evaluate the issues in macro-economic analysis.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Micro and Macro economics - Kinds of Economic Systems - Production Possibility Frontier - Opportunity Cost - Objective of Organizations - Kinds of Organization.

UNIT II **9 Hours**

DEMAND AND SUPPLY

Functions of Demand and Supply - Law of diminishing Marginal Utility - Law of Demand and Supply - Elasticity of Demand - Demand Forecasting Methods - Indifference curve.

UNIT III **9 Hours**

PRODUCTION AND COST

Production Function - Returns to Scale - Law of Variable Proportion - Cost and Revenue concepts and Cost Curves - Revenue curves - Economies and Dis-economies of scale - Break Even point.

UNIT IV **9 Hours**

MARKET STRUCTURE

Market Structure - Perfect Competition - Monopoly - Monopolistic - Oligopoly - Components of Pricing - Methods of Pricing - Capital Budgeting IRR - ARR - NPV - Return on Investment - Payback Period.

UNIT V **9 Hours**

INTRODUCTION TO MACRO ECONOMICS AND FINANCIAL ACCOUNTING

National Income - Calculation Methods - Problems - Inflation - Deflation - Business Cycle - Taxes - Direct and Indirect Taxes - Fiscal and monetary policies.

FOR FURTHER READING

Nature and characteristics of Indian Economy - Role and functions of Central bank - LPG - GATT - WTO.

Total: 45 Hours

Reference(s)

1. A Ramachandra Aryasri and V V Ramana Murthy, Engineering Economics and Financial Accounting, Tata McGraw Hill Publishing Company Limited, New Delhi, 2006.
2. V L Samuel Paul and G S Gupta,Managerial Economics Concepts and Cases, Tata McGraw Hill Publishing Company Limited, New Delhi, 1981.
3. R Kesavan, C Elanchezhian and T Sunder Selwyn, Engineering Economics and Financial Accounting, Laxmi Publication (P) Ltd, New Delhi, 2005.
4. S N Maheswari, Financial and Management Accounting, Sultan Chand
5. V L Samuel Paul and G S Gupta, Managerial Economics-Concepts and Cases

16FD702 FOOD PACKAGING TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the properties of food packaging materials and their suitability in extending shelf life of food products
- Impart knowledge on rationale in selecting packaging material for processed food products
- Learn about laws and regulations of packaging materials and labeling of foods
- To acquaint in pricing methods, payback and competition in modern market structure
- To obtain knowledge on macro economics, various taxes and financial accounting procedures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Explain and apply the functions of food packaging for socio economic needs
2. Differentiate the packaging methods for the extension of shelf life of food products
3. Apply the advanced packaging methods and explain its merits and demerits
4. Attribute the different filling systems for whole and ground food products
5. Analyze the testing and labeling regulatory requirements with respect to food packaging

Articulation Matrix

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

UNIT I **9 Hours**

FUNCTIONS OF FOOD PACKAGING MATERIALS

Introduction- Science and technology of food packaging- Socio economic needs - functions of food packaging- Food Packaging environments- functions and environments grids-Food packaging systems-Food package development.

UNIT II **9 Hours**

RIGID AND SEMI RIGID FOOD PACKAGING MATERIALS

Glass as food packaging materials- advantages and disadvantages- closures used for glass containers-metal containers-tinplate - three piece can manufacture - double seaming - protective coatings-aluminium as food packaging materials- two piece can manufacturing process- kegs-drums-trays-wood as packaging material- solid fibre board boxes. Aseptic packaging- multilayer packaging materials- retort packaging materials.

UNIT III **9 Hours**

FLEXIBLE FOOD PACKAGING MATERIALS

Paper - different types - corrugated paper boards- definition - types - manufacturing method-paper board products - Polymer - basic concept of polymer- polymerization- plastics versus polymers- Advantages and disadvantages of plastics- polymer properties - molecular weight - chain entanglement- plastics - morphology-definition- different types of food packaging polymers- polymer processing methods- heat sealing - adhesives and labels-Nano composite food packaging materials- bio-degradable food packaging materials- bag in box system of food, Smart packaging, Intelligent packaging, Modified atmospheric packaging and control atmospheric storage.

UNIT IV **9 Hours**

FILLING SYSTEMS

Filling of liquid and wet products- to predetermined level and predetermined volume- filling of dry solids- by count- volume-weight - methods of wrapping and bagging- form -fill -seal methods- various forms of packaging - vacuum packaging- blister packaging-shrink packaging - stretch packaging.

UNIT V **9 Hours**

TESTING AND LABELING OF PACKAGING MATERIALS

Principles of measuring water vapour transmission rate and gas permeability rate through given flexible film, OUR from food and OTR from film .Testing of packaging materials using - UTM- Mullen Bursting strength tester- drop tester- Pouch burst tester- cob tester- gauge tester- torque tester- tear tester- gas analyzer-cushioning materials. Labeling, regulation and traceability. Global migration testing and design aspects.

FOR FURTHER READING

Difference between packing and packaging, Manufacturing of nano packaging, Degradation of plastic materials, Alternate for plastic/glass material, Eco friendly packaging material.

Total: 45 Hours

Reference(s)

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Second Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2005.
3. NIIR Board, Food Packaging Technology Handbook (2nd Revised Edition), NIIR Project Consultancy Services, 2012.
4. Richard Coles and Mark J. Kirwan, Food and Beverage Packaging Technology, Second Edition, Wiley & Blackwell, 2011.
5. K.L. Yam and D.S. Lee, Emerging Food Packaging Technologies, Principles and Practice, A volume in Woodhead Publishing series in Food Science, Technology and Nutrition, 2012.
6. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, Food Packaging Science and Technology, CRC Press, 2008.

16FD703 FOOD PLANT LAYOUT AND MANAGEMENT

3 2 0 4

Course Objectives

- Impart basic knowledge in selecting a location as well as plant layout with respect to material handling, space utilization, future expansion etc.
- Understand the importance of availability of raw material and facilities for production of goods
- Integrate man, materials and machinery for optimum production

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Design layout for various types of food processing industries.
2. Construct project profile analysis and prepare project report
3. Design water storage systems and prepare electrical layout
4. Apply different methods for production planning
5. Demonstrate the repair and maintenance of equipment.

Articulation Matrix

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

UNIT I **15 Hours**

PLANT LOCATION AND LAYOUTS

Introduction to food plant design - special features of food and agricultural process industry - plant location - location factors, site selection, location theory and models - layout - objectives, classical and practical layout - preparation of process chart and machinery layout - product layout and process layout - plant layout for size reduction machinery, evaporation plant, drying plant, bake ovens and frying plant, heat exchanger plant, refrigeration and air conditioning plant, boiler, packaging plant and ancillary equipments plant.

UNIT II **15 Hours**

PROJECT PROFILE ANALYSIS

Project profile, key aspects to consider in preparing a project profile and DPR (Detailed Project Report), Describing Project Operations, Categorizing Costs, Environmental Sustainability, completing and interpreting the profile, Project Profile Formats, Preparing model project report on fruit and vegetable processing unit.

UNIT III **15 Hours**

ELECTRICAL AND WATER SUPPLY

Estimation of services - peak and critical load - preparation of electrical layout - selection of fittings and accessories for electrical and water supply - provision of water supply - design of water storage system - selection of pipe, valves and safety devices - drainage - systems, pipeline, traps, safety devices - illumination and ventilation - materials, mounting, operation and maintenance - layout for effluent treatment plant - safe disposal of effluent.

UNIT IV **16 Hours**

PRODUCTION PLANNING AND CONTROL

Production planning and control - continuous and intermittent production - scheduling - routing and dispatching - activity chart and Gantt chart - net work planning methods - PERT and CPM - applications - method study - work study - methods - man-machine chart - time study - standard time of a job - inventory control - economic ordering quantity - inventory models.

UNIT V **14 Hours**

REPAIR AND MAINTENANCE OF EQUIPMENT

Repair and maintenance of equipment - preventive maintenance and breakdown maintenance - replacement of equipment - alternative methods and analysis - method of annual equivalence, present worth method and internal rate of returns.

FOR FURTHER READING

PERT, CPM, Queuing theory, Break Even Point, DPR for fruit & Vegetable processing industry

Total: 75 Hours

Reference(s)

1. O.P.Kanna, Industrial Engineering and Management, DhanpatRai Publication (P) Ltd., New Delhi, 2003.
2. S.P. Arora and S.P. Bindra, A Text Book of Building Construction, 5th edition, Dhanpat Rai Publications (p) Ltd., New Delhi, 2014.
3. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A., 2003.
4. Antonio Lopez-Gomez and Gustavo V. Barbosa-Canovas, Food Plant Design, CRC, London, 2005.
5. C.S.Rao, Environmental Pollution Control Engineering, New age International (P) Ltd., New Delhi, 1999.
6. G.K. Agarwal, Plant layout and materials handling, Jain brothers, New Delhi, 2008.

16FD704 FOOD SAFETY AND QUALITY REGULATIONS

3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of foodborne illness - viz. physical, chemical and biological.- and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Analyse the sources of food spoilage and food toxicants.
2. Identify the food quality evaluation methods.
3. Execute the food inspection procedures to evaluate the food quality
4. Select the National and International Food laws and regulations.
5. Evaluate the quality control measures in food processing industry and marketing centers

Articulation Matrix

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

UNIT I **9 Hours**

FOOD SAFETY

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and microorganisms- microbial problems in food safety-food toxicants and food poisoning - prevention. Cross contamination, Limits for pesticide and metal contamination of food. Adulteration, Food additives- types- usage, permissible limits, concept of safe food.

UNIT II **9 Hours**

FOOD QUALITY AND QUALITY EVALUATION OF FOODS

Food Quality - its need and its role in Food Industry. Food Quality and Quality Attributes- Classification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials-Fruits, vegetables, cereals, legumes, dairy products, meat, poultry, egg and processed food. Sensory Evaluation of Food Quality. Requirements for conducting Sensory Evaluation, Methods of Sensory Evaluation and Evaluation cards, Different methods of Quantitative descriptive analysis.

UNIT III **9 Hours**

QUALITY CONTROL

Objectives, Importance and Functions of Quality Control, Quality control specifications, training of food technologists for quality control, implementation of standards and specifications. Quality control, principles of quality control - raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques- mechanization, future of quality control, Total quality management. Objective/Instrumental analysis of Quality Control.

UNIT IV **12 Hours**

NATIONAL AND INTERNATIONAL FOOD LAWS AND STANDARDS

Standards for food packaging and labeling - FSSAI, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The Agricultural and Processed Food Product Export Development Authority (APEDA), MPEDA. Food and Drug Administration Act (FDA), International Organization for Standards (ISO) and its implication, Generally recognized as safe (GRAS), European Council (EU) , Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good

Manufacturing Practices (GMP), Good Agricultural Practices(GAP), and Good Hygienic Practices (GHP) , GMP, Hazard Analysis Critical Control Point (HACCP), FSMA, Legal Metrology Rules, Food Safety Standards for Organic foods, GFSi, HALAL and KOSHE.

UNIT V **6 Hours**

QUALITY CONTROL MEASURES IN INDUSTRIAL AND MARKETING CENTRES

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

FOR FURTHER READING

Nutritional labeling, labeling regulations, FSSAI, Regulations for organized and unorganized food industries.

Total: 45 Hours

Reference(s)

1. Manoranjan Kalia, Food analysis and Quality control, Kalyani Publishers, Ludhiana, 2002.
2. Mehta, Rajesh and J. George, Food Safety Regulation Concerns and Trade: The Developing Country Perspective, Macmillan, 2005.
3. P.A. Luning, F. Devlieghere and R. Verhe, Safety in the agri - food chain, Wageningen Academic Publishers, Netherland, 2006.
4. Leo and M.L. Nollet, Handbook of food analysis - Methods and Instruments in applied food analysis, Marcel Dekker Inc., 2004.
5. A Krammer, Quality Control for Food Industry, Vol I and II AVI Publications.
6. S. Ranganna, Manual of analysis of fruits and vegetable products, Tata Mc- Graw Hill publication company Ltd, New Delhi, 1997.

16FD707 FOOD PACKAGING LABORATORY 0 0 2 1

Course Objectives

- Understand the properties and uses of various packaging materials
- Impart skills related to food packaging technology
- Become familiar with different forms of packaging ‘ box, bottle, tetra, pouch, vacuum, gas, CAP, MAP, asceptic etc.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand and apply fundamental requirement for packed foods
2. Select a suitable packaging materials for perishable and non-perishable foods
3. Demonstrate a testing and properties of packaging materials for its regulatory requirements for raw and processed foods
4. Analyze the textural properties of packaging material and food packed inside the packaging materials
5. Evaluate the quality of packing materials using latest machineries

Articulation Matrix

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

1 **2 Hours**

EXPERIMENT 1
Global migration testing for packaging

2 **4 Hours**

EXPERIMENT 2
Measuring GSM of various paper and flexible film based packaging materials.

3 **4 Hours**

EXPERIMENT 3
Measuring water absorption by different paper and paper boards using Cobb tester.

4 **4 Hours**

EXPERIMENT 4
Measuring tensile strength of flexible films using UTM.

5 **4 Hours**

EXPERIMENT 5

Measuring compressive strength of carton boxes using UTM.

6 **2 Hours**

EXPERIMENT 6

Measuring drop strength of packaged food material using drop tester

7 **2 Hours**

EXPERIMENT 7

Measuring compressive strength of oil packaged in flexible pouches using Pouch burst tester.

8 **4 Hours**

EXPERIMENT 8

Measuring bursting strength of different paper board based packaging materials.

9 **2 Hours**

EXPERIMENT 9

Experiment on opening and closing torques of foods packed in bottles/Jars using torque tester.

10 **2 Hours**

EXPERIMENT 10

Experiment on form fill seal machine - vertical type.

Total: 30 Hours

16FD708 FOOD ANALYSIS AND QUALITY CONTROL LABORATORY

0 0 2 1

Course Objectives

- Provide knowledge on food quality standards
- Understand role of food additives and their permissible limits
- Know food laws of India for consumer as well as industry

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Demonstrate simple detection methods of food adulteration
2. Identify pathogenic microorganisms responsible for food spoilage
3. Assess the control of food spoilage
4. Execute the food laws of the country and their compliance
5. Implement the hygienic practices in food processing industry.

Articulation Matrix

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

1 **4 Hours**

EXPERIMENT 1

Determination of colour value using Hunter lab

2 **2 Hours**

EXPERIMENT 2

Estimation of chemical preservative

3 **2 Hours**

EXPERIMENT 3

Identification of food adulterants in Honey

4 **2 Hours**

EXPERIMENT 4

Identification of food adulterants in solid foods

5 **4 Hours**

EXPERIMENT 5
Determination of allergen in foods using ELISA test.

6 **4 Hours**

EXPERIMENT 6
Quality analysis of liquid juice.

7 **2 Hours**

EXPERIMENT 7
Determination of hardness and TDS in water.

8 **2 Hours**

EXPERIMENT 8
Development of HACCP schedule for food industries

9 **2 Hours**

EXPERIMENT 9
Sensory evaluation of biscuit samples for textural properties.

10 **2 Hours**

EXPERIMENT 10
To determine BAR (Brix acid ratio) in beverages

11 **4 Hours**

EXPERIMENT 11
Determination of total residual chlorine in water sample

Total: 30 Hours

16FD709 MINI PROJECT V 0 0 2 1

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

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

Total: 30 Hours

16FD804 PROJECT WORK **0 0 18 9**

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Articulation Matrix

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

LANGUAGE ELECTIVE

15LE101 BASIC ENGLISH I **3 0 0 3**

Course Objectives

- To teach students basic English vocabulary and tenses
- To offer practice on various conversation patterns
- To improve spelling and pronunciation by offering rigorous practice and exercises

Programme Outcomes (POs)

Course Outcomes (COs)

1. Students will be able to: Form sentences using basic grammar and vocabulary in English
2. Involve in basic day-to-day conversation
3. Express opinions, agree & disagree on topics of general interest
4. Listen and understand Indian English audio clippings
5. Understand reading comprehension passages and answer related questions

UNIT I **7 Hours**

UNIT I

Module	Vocabulary/ Grammar Skills Sets	Skill Sets
1	Basic words- 12 most used words in English, usage and pronunciation	Starting a conversation and talking about what one does Sentence construction bolstered by mother tongue
2	Basic words- 20 often used words, usage and pronunciation	Analyzing an action plan Creating and presenting oneÃƒÂ¢??s own action plan
3	Basic words with a focus on spelling	Discriminative listening Informal conversation
4	Basic words- 10 often used words, usage and pronunciation	Content listening and Intonation Reading comprehension
5	Unit Test I	

UNIT II **8 Hours**

UNIT II

Module	Vocabulary/ Grammar Skills Sets	Skill Sets
6	Basic words + greetings to be used at different times of the day	Formal conversation Intonation to be used in formal address
7	Last 28 of the 100 most used words	Informal conversation between equals Reading practice and peer learning
8	Using the 14 target words to form bigger words	Informal dialogues using contracted forms Guided speaking- talking to peers using contracted forms
9	Palindromes, greetings- good luck, festivals	Placing a word within its context- culling out meaning Offering congratulations
10	Unit Test II	

UNIT III **7 Hours**

UNIT III

Module	Vocabulary/ Grammar Skills Sets	Skill Sets
11	Homophones	Formal and informal methods of self-introduction Let's Talk is a group activity that gives them some important pointers of speech
12	Homophone partners, matching words with their meanings	Contracted forms of the -be verbs, -ve and -s Translating English sentences to Tamil
13	Briefcase words- finding smaller words from a big word	Formal and informal ways of introducing others Team work- speaking activity involving group work, soft skills

14 Compound words and pronunciation pointers Giving personal details about oneself using the lexicon
15 Unit Test III

UNIT IV **8 Hours**

UNIT IV

Module Vocabulary/ Grammar Skills Sets Skill Sets
16 Proper and common nouns Asking for personal information and details Pronunciation pointers- an informal introduction to the IPA
17 Pronouns Telephone skills and etiquette Reading aloud and comprehension
18 Abstract and common nouns Dealing with a wrong number Reading practice and comprehension
19 Group names of animals, adjectives Taking and leaving messages on the telephone Pronunciation pointers
20 Unit Test IV

UNIT V **8 Hours**

UNIT V

Module Vocabulary/ Grammar Skills Sets Skill Sets
21 Determiners Interrupting a conversation politely- formal and informal Pair work reading comprehension
22 Conjugation of the verb to be- positive and negative forms Thanking and responding to thanks Comprehension questions that test scanning, skimming and deep reading
23 Am/is/are questions Giving instructions and seeking clarifications Small group activity that develops dialogue writing
24 Present continuous tense-form and usage Making inquiries on the telephone Finishing sentences with appropriate verbs
25 Unit Test V

UNIT VI **7 Hours**

UNIT VI

Module Vocabulary/ Grammar Skills Sets Skill Sets
26 Words with silent 'b' Present continuous questions Calling for help in an emergency Dialogue writing
27 Words with silent 'c' Simple present tense- form and usage Making requests and responding to them politely Identifying elements of grammar in text extract
28 Simple present tense- rules Describing people Guided writing
29 Words with silent 'g' Questions in the simple present tense Describing places Filling in the blanks with correct markers of tense
30 Unit Test VI

Total: 45 Hours

Reference(s)

1. 1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE102 COMMUNICATIVE ENGLISH I 3 0 0 3

Course Objectives

- To communicate effectively in social scenario
- To enhance the ability of reading, summarising and paraphrasing information
- To develop the techniques of writing through appropriate use of grammar and vocabulary

Programme Outcomes (POs)

Course Outcomes (COs)

1. Listen and comprehend different spoken discourses
2. Communicate ideas in English fluently during personal / official conversations
3. Use grammar and vocabulary required at CEFR B1 level in spoken and written discourses
4. Read and understand general & technical text
5. Involve in formal written communication using appropriate mechanics of writing

UNIT I **9 Hours**

UNIT I: GRAMMAR

Content words- Structural words - Subject - Verbs and verb phrase - Subject - Verb agreement - Tenses - Active voice and passive voice - Sentence types (declarative, imperative, exclamatory & interrogative) - Framing questions - Comparative adjective

UNIT II **9 Hours**

UNIT II: LISTENING

Listening for specific information: Short conversations / monologues - Impersonal passive - Gap filling - Telephone conversations - Note-taking - Listening for gist / interviews - Listening to songs and completing the lyrics - Clear individual sounds - Telephone etiquette

UNIT III **9 Hours**

UNIT III: READING

Prediction - Skimming for gist - Scanning for specific information - Understanding text and sentence structure - Note Making

UNIT IV **9 Hours**

UNIT IV: WRITING

Letter Writing: Formal letters / Job application - E-mail writing Ã¢?? Report & Proposal writing - Advertisement - Principles of writing a good paragraph: Unity, cohesion and coherence - Paragraph writing (descriptive, narrative, expository & persuasive)

UNIT V **9 Hours**

UNIT V: SPEAKING

Self-introduction (Elevator Pitch) - Giving personal and factual information - Talking about present circumstances, past experiences and future plans - Mini-presentation - Expressing opinions and justifying opinions - Likes and dislikes - Tongue twisters

FOR FURTHER READING

Short stories:
"The Astrologer's Day" by R. K Narayan
"How Much Land does a Man Need?" by Leo Tolstoy

Total: 45 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use - A Self-Study Reference and Practice Book For Intermediate Learners Of English .IVed. United Kingdom: Cambridge University Press. 2012.
2. 2.Seely, John. Oxford Guide to Effective Writing and Speaking. Indian edition. New Delhi: Oxford University Press. 2005.
3. 3. Anderson, Kenneth. Study Speaking: A Course in Spoken English for Academic Purposes. United Kingdom: Cambridge University Press. 2004.

15LE201 BASIC ENGLISH II 3 0 0 3

Course Objectives

- To focus on natural acquisition of rudimentary structures in English language through ample listening, reading and writing inputs
- To concentrate on speaking and conversation skills with a view to increase fluency in speaking
- To enhance the ability of correct pronunciation and spelling

Programme Outcomes (POs)

Course Outcomes (COs)

1. The students will be able to: Express themselves clearly in English to individuals / groups without hesitation
2. Use various forms of tenses in speaking and writing
3. Read and understand paragraphs on simple topics
4. Write coherent paragraphs / reports / letters on familiar topics

UNIT I **8 Hours**

UNIT I

Module Vocabulary/ Grammar Skills Sets Skill Sets

31 Difference between Present Continuous and Simple Present tense. Calling for help in an emergency Reporting an event- journalistic style

32 Verbs 'have' and 'have got' Describing animals Asking for and giving directions

33 Simple Past Tense Inviting people, accepting and declining invitations Self-enquiry and offering one's opinion on a given topic.

34 Spelling rules & table of Irregular Verbs Refusing an invitation Reading and practicing pre-written dialogues

35 Unit Test I

UNIT II **8 Hours**

UNIT II

36 Questions and the negative form of the simple past tense Apologizing and responding to an apology (Reading) conversation practice

37 Asking questions in the simple past tense Reading comprehension Seeking, granting and refusing permission

38 Past continuous tense Paying compliments and responding to them Pair work: writing dialogues and presenting them

39 Difference between simple past and past continuous- when and where to use each Describing daily routines Reading and comprehension skills

40 Unit Test II

UNIT III **7 Hours**

UNIT III

41 Simple future tense Talking about the weather Making plans- applying grammar theory to written work

42 Simple future tense- more aspects, possessive pronouns Talking about possessions Opening up and expressing one's emotions

43 Future continuous tense Talking about current activities Listening comprehension

44 Revision of future tense- simple and continuous forms, prepositions used with time and date

Asking for the time and date Discussion- analyzing and debating a given topic
45 Unit Test III

UNIT IV **8 Hours**

UNIT IV

46 Articles a/an Writing, speaking and presentation skills Transcribing dictation
47 Singular- Plural (usage of a/an) Reading practice- independent and shared reading Comprehension - logical analysis, process analysis and subjective expression
48 Countable and uncountable nouns- a/an and some Listening comprehension Vocabulary: using context tools to decipher meaning
49 Articles- the Sequencing sentences in a paragraph Listening to a poem being recited, answer questions on it and practice reciting the same
50 Unit Test IV

UNIT V **7 Hours**

UNIT V

51 Articles- the: usage and avoidance Speaking: sharing stories about family, village/town, childhood, etc. 10 students Listening: comprehend and follow multiple step instructions read out by the teacher
52 Articles- the: usage and avoidance with like and hate Speaking: sharing stories about family, village/town, childhood, etc. 10 students Reading: make inferences from the story about the plot, setting and characters
53 Articles- the: usage and avoidance with names of places Speaking: sharing stories about family, village/town, childhood, etc. 10 students Comprehension passage
54 This/ that/ these and those Writing a notice- announcement Speaking: Debate
55 Unit Test V

UNIT VI **7 Hours**

UNIT VI

56 One and ones Collaborative learning- problem solving Writing short answers to questions based on reading
57 Capitalization and punctuation Controlled writing Listen to a story and respond to its main elements
58 Syntax and sentence construction- rearrange jumbled sentences Guided writing Listen to a poem and discuss its elements
59 Cloze Free writing Frame simple yet purposeful questions about a given passage
60 Unit Test VI

Total: 45 Hours

Reference(s)

1. Basic English Module, L&L Education Resources, Chennai, 2011.

15LE202 COMMUNICATIVE ENGLISH II 3 0 0 3

Course Objectives

- To acquire skills for using English language effectively in workplace
- To prepare students for taking BEC Vantage level examination
- To enhance the communicative ability from Intermediate to Upper Intermediate level
- To enhance the communicative ability from Intermediate to Upper Intermediate level

Programme Outcomes (POs)

Course Outcomes (COs)

1. The students will be able to: Express themselves orally while interacting with individuals or groups in formal occasions
2. Listen and comprehend business conversations
3. Read and understand business correspondences and company literature
4. The students will be able to use language structures and vocabulary that is required at CEFR B2 level
5. Communicate effectively through formal and informal written business correspondences

UNIT I **9 Hours**

UNIT I: GRAMMAR AND VOCABULARY

Simple, Compound and Complex sentences - Direct and Indirect speech - Conditionals -Business vocabulary - Collocations - Discourse markers

UNIT II **9 Hours**

UNIT II: LISTENING

Listening to specific information - short notes - Listening to identify topic, content, function - Sentence stress - Rhythm - Intonation

UNIT III **9 Hours**

UNIT III: READING

Reading graphs and charts - Skimming and scanning texts - Gap Filling - Read business articles for specific information - Understanding the structure of a text - Error identification

UNIT IV **9 Hours**

UNIT IV: WRITING

Formal and Informal English - Business Correspondence, Short Documents: e-mail, memo, message, - Longer Documents: Reports and Proposals - Transcoding

UNIT V **9 Hours**

UNIT V:SPEAKING

Collaborative task - Turn taking (initiating and responding appropriately) - Negotiating - Exchanging information - Language Functions: suggesting - comparing and contrasting -expressing - Finding out facts, attitudes and opinions - Commonly mispronounced words

FOR FURTHER READING

Newspaper and Magazine reading (The Hindu / The New Indian Express / Times of India, India Today / ReadersÃ¢?? Digest) - Reading Novels (The Monk Who Sold His Ferrari by Robin Sharma; Three Mistakes by Chetan Bhagat; The Fountain head by Ayn Rand)

Total: 45 Hours

Reference(s)

1. 1.Guy Book- Hart, BEC Vantage Cambridge Business Benchmark, Upper-Intermediate Cambridge University Press, 2006.
2. 2.Eric H. Glendinning and Beverly Holmstrom, Study Reading: A Course in Reading for Academic Purposes. United Kingdom: Cambridge University Press, 2004.

15LC203 CHINESE **3 0 0 3**

Course Objectives

- To help students acquire the basics of Chinese language.
- To teach the student show to converse in Chinese in various situations.
- To teach Chinese cultural facets and social etiquettes to the students.

Programme Outcomes (POs)

Course Outcomes (COs)

1. Identify Initials and Finals of Chinese Alphabet.
2. Recognise four different tones in a spoken Chinese sentence.
3. Read Mandarin Chinese through Pinyin.
4. Form sentences using basic Chinese vocabulary.
5. Listen and understand basic Chinese conversation

UNIT I **9 Hours**

NÃ‡?HÃ‡?O-Ã„Â½Â Ã...Â¥Â½

XuÃƒÂ©huÃƒÂ¬wÃƒÂ¨nhÃƒÂ²u de jÃ„Â«bÃ„?nbiÃ‡?odÃƒÂ¡yÃƒÂ²ngyÃ‡? - Ã¥Â-Â¦Ã¤Â¼?Ã©?Â®Ã¥??Ã§??Ã¥?Â°Ã¦?Â¬Ã¨Â¡Â¨Ã¨Â¾Â¾Ã§?Â¨Ã¨Â¯Â ;
XuÃƒÂ©huÃƒÂ¬jiÃƒÂ¨shÃƒÂ ozÃƒÂ¬jÃ‡? de xÃƒÂ¬ngmÃƒÂng, guÃƒÂ³jÃƒÂ - Ã¥Â-Â¦Ã¤Â¼?Ã¤Â»?Ã§Â»?Ã¨?Âª Ã¥Â·Â±Ã§??Ã¥Â§?Ã¥??Ã¯Â¼?Ã¥?Â½Ã©?? ;
XuÃƒÂ©huÃƒÂ¬hÃƒÂ nyÃ‡?pÃ„Â«nyÃ„Â«n de shÃƒÂ¨ngmÃ‡? - Ã¥ÂÂ¦Ã¤Â¼?Ã¦Â±?Ã¨Â¯Â-Ã¦?Â¼Ã©?Â³Ã§??Ã¥?Â£Ã¦Â¯? ; yÃƒÂ¹nmÃ‡?hÃƒÂ©shÃ„?ngdiÃƒÂ o - Ã©?ÂµÃ¦Â¯?Ã¥??Ã¥Â£Â°Ã¨Â°? ; PÃ„Â«ndÃƒÂºhÃƒÂ©shÃ„?ngdiÃƒÂ oliÃƒÂ nxÃƒÂ - Ã¦?Â¼Ã¨Â¯Â»Ã¥??Ã¥Â£Â°Ã¨Â°?Ã§Â»?Ã¤Â¹Â

UNIT II **9 Hours**

UNIT 2

XiÃ nzÃ ij?di?n-????

XuÃ©huÃ¬shÃji?n, rÃ¬qÃ de bi?odÃ¡ - ?????????? ; RÃ¨sh?n - ?? ; Sh?ngcÃ - ?? ; JÃ¹zi - ?? ; HuÃ¬huÃ - ?? ;HuÃ³dÃ²ng - ?? ; KÃ ntÃºwÃ¡nchÃ©nghuÃ¬huÃ - ?????? ; XuÃ©cÃy?shu?shÃji?n ; TÃ¬huÃ nliÃ nxÃ - ????DÃºy?dÃºrÃ¡nhÃ²uliÃ¡nxiÃ n - ??????? ; B?xiÃ miÃ n de cÃ-Ã nzhÃ¨ngquÃ¨ de shÃ¹nxÃ¹pÃ¡iliÃ¨chÃ©ngjÃ¹ - ??????????????

UNIT III **9 Hours**

UNIT 3

NÃ jiÃ nmÃ¡oy?z?nmemÃ i? - ??????? ?
XÃºnwÃ¨njiÃ qiÃ¡njÃqiÃ¡n de bi?odÃ¡ - ????????? ; T?ojiÃ huÃ¡njiÃ - ???? ; TÃ-ch?duÃ¬su?m?id?ngx?dÃ xi?o, yÃ¡nsÃ¨d?ngd?ngjÃ¹t?y?oqiÃº - ???????????????? ; Sh?ngcÃ-HuÃ³dÃ²ng - ?? ; KÃ ntÃºwÃ¡nchÃ©nghuÃ¬huÃ - ?????? ; XuÃ©cÃy?shu?shÃji?n ;DÃºy?dÃºrÃ¡nhÃ²uliÃ¡nxiÃ n - ??????? ;T?nglÃ¹y?nxu?nzÃ©zhÃ¨ngquÃ¨dÃ¡'Ã n - ????????? ; B?ch?ngcÃy?bi?o - ?????

UNIT IV **9 Hours**

UNIT 4

XuÃ©huÃ¬xÃºnwÃ¨nji?tÃngqÃngkuÃ ng, zhÃyÃ¨hÃ©niÃ¡nlÃng - ????????????? XuÃ©huÃ¬di?ncÃ itÃy?oqiÃºjiÃ©zhÃ ng - ????????? ; Sh?ngcÃ - ?? ; JÃ¹zi - ?? ; HuÃ¬huÃ - ?? ;HuÃ³dÃ²ng - ?? ; KÃ ntÃºwÃ¡nchÃ©nghuÃ¬huÃ - ?????? ; XuÃ©cÃy?shu?shÃji?n ;DÃºy?dÃºrÃ¡nhÃ²uliÃ¡nxiÃ n - ??????? ;T?nglÃ¹y?nxu?nzÃ©zhÃ¨ngquÃ¨dÃ¡'Ã n - ????????? ; B?ch?ngcÃy?bi?o - ?????JuÃ©sÃ¨bÃ ny?n - ???? ; T?nglÃ¹y?npÃ nduÃ nduÃ¬cuÃ² - ???????

UNIT V **9 Hours**

UNIT 5

N?zÃ in?'erg?ngzuÃ² -??????

XuÃ©huÃ¬xÃºnwÃ¨nji?tÃngqÃngkuÃ ng, zhÃyÃ¨hÃ©niÃ¡nlÃng - ??????????????Sh?ngcÃ - ?? ; JÃ¹zi - ?? ; HuÃ¬huÃ - ?? ; HuÃ³dÃ²ng - ?? ; KÃ ntÃºwÃ¡nchÃ©nghuÃ¬huÃ - ?????? ;T?nglÃ¹y?nxu?nzÃ©zhÃ¨ngquÃ¨dÃ¡'Ã n - ????????? ; B?ch?ngcÃy?bi?o - ????? - T?nglÃ¹y?nxu?nzÃ©zhÃ¨ngquÃ¨dÃ¡'Ã n - ????????? ; B?ch?ngcÃy?bi?o - ?????

Total: 45 Hours

Reference(s)

1. David J. White. My Chinese Classroom, 2005
2. Tiyan Hanyu Shenghuo Pian, Experiencing Chinese, Ying Yu Ban Di 1 Ban. Beijing: Higher Education Press: Gaodengjiaohuchu ban she. 2011
3. Hancel, Don. Mandarine Day. Chinese learning Software
4. www.chinesexp.com.cn www.yiwen.com.cn

15LF203 FRENCH 3 0 0 3

Course Objectives

- To help students acquire familiarity in the French alphabet & basic vocabulary
- To teach the students to use French in simple day-to-day conversations
- To prepare the students for French examination (level A1)

Programme Outcomes (POs)

Course Outcomes (COs)

1. Listen and comprehend individual sounds of French and simple day-to-day conversations.
2. Apply basic sounds and words in simple sentences for communication
3. Read and understand short passages on familiar topics.
4. Frame basic sentence structures while writing.
5. Recognize and apply basic grammar and appropriate vocabulary in completing language tasks.

UNIT I **6 Hours**

UNIT 1

Alphabet FranÃƒÂ§ais et Les Accents FranÃƒÂ§ais - Les articles dÃƒÂ©finis, indÃƒÂ©finis Genre - Singulier et pluriel - Salutations

UNIT II **8 Hours**

UNIT II

Verbes - Conjugaison : PrÃƒÂ©sent (Avoir / Ãƒ?tre / ER, IR, RE : RÃƒÂ©gulier et IrrÃƒÂ©gulier) - Adjectifs - NationalitÃƒÂ©s - Professions - Formuler les questions LIRE

UNIT III **10 Hours**

UNIT 3

Moyens de transport (Transport) - Noms de Professions (Professions) - Noms d'endroits communs (Places) - NationalitÃ©s (Nationalities)ECOUTER : (Listening) Ã‰couter l- alphabet associÃ©Ã des prÃ©noms franÃ§ais - Ã‰couter et rÃ©pondre PARLER (Speaking)PrÃ©sntation - mÃªme /PrÃ©sentez- Vous (Introducingoneself)LIRE :Lireles phrases simples

UNIT IV **12 Hours**

UNIT 4

Pronoms (Pronouns) - Noms communs masculins et de femme (Common masculine and Femininenouns) - Verbes communs (Common verbs)COUTER :couter et crier les prnoms - Observer les dessins et couter les dialogues LIRE : Lire les profils d'utilisateurs d'interlingua (alter ego)PARLER :Parler de sa ville - Parler de sa profession

UNIT V **9 Hours**

UNIT 5

Narration de son nom et l'endroit oÃ¹ on vit - Son Ã¢ge et date de naissance - NumÃ©ro de tÃ©lÃ©phone et'dresse - Narration du temps - La France en Europe PARLER :Conversation entre deux amis - Jouer la scÃ¨ne Ã‰COUTER :Ecouter les conversations (CD alter ego)Ã‰CRIRE :Ã‰crireune carte postale

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du FranÃƒÂ§ais, CLÃƒ? International, 2010.
2. Collins Easy Learning French Verbs & Practice, Harper Collins, 2012
3. BarronÃƒÂ¢'s Learn French, 3rd Edition, Elizabeth Bourquin, Language Institute, 2012
4. Cours de Langue et de Civilisation FranÃƒ?Ã‚Â§aises, G. Mauger, Hachette, 2014
5. Saison 1, Marie-Noelle Cocton et al, Didier, 2014
6. FranÃƒÂ§ais Linguaphone, Linguaphone Institute Ltd., London, 2000. FranÃƒÂ§ais Harrisonburg: The Rosetta Stone: Fairfield Language Technologies, 2001.

15LG203 GERMAN **3 0 0 3**

Course Objectives

- To help students acquire the basics of German language.
- To teach them how to converse in German in day-to-day situations. Ã?Ã‚¢?Ã?Ã‚¢ To teach them how to converse in German in day-to-day situations

Programme Outcomes (POs)

Course Outcomes (COs)

1. Listen and identify individual sounds of German and simple day-to-day conversations.
2. Speak simple sentences using basic sounds and words.
3. Read and understand short passages on familiar topics.
4. Apply basic sentence structures while writing.
5. Apply basic grammar and appropriate vocabulary in completing language tasks.

UNIT I **6 Hours**

UNIT I

Introduction to German language: Alphabets - Numbers -Greetings - country - nationalities - Working with Dictionary.

UNIT II **6 Hours**

UNIT II

Nouns - Pronouns - definite and indefinite article - Speaking about oneself - Listening to CD supplied with the books, paying special attention to pronunciation.

UNIT III **11 Hours**

UNIT III

Regular verbs - Conjugation - Irregular verbs - Time - Negation - adjectives - family - profession - Introduction to types of sentences.

UNIT IV **12 Hours**

UNIT IV

Question words - Types of Questions - Nominative - Accusative and dative case - framing basic questions and answers -Writing short notes and letter- reading the news boards, directions.

UNIT V **10 Hours**

UNIT V

Imperative case - Possessive articles - propositions - modal auxiliaries - Basic dialogue and group conversation -ordering in restaurants.

Total: 45 Hours

Reference(s)

1. Continuum International Publishing Group Ltd. London / New York, 1992. Eckhard, Christine. Whittle, Black & Ruth. Cassel Language Guides - German.
2. Rusch, Paul. Netzwerk A1. Deutsch AlsFremdsprache. Goyal Publishers & Distributers Pvt. Ltd. New Delhi, 2015.
3. Langenscheidt Universal German Dictionary: German-English, English-German. Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
4. Grundkurs Deutsch A Short Modern German Grammar Workbook and Glossary. Verlag Fur Deutsch.Munichen, 2007.
5. Grundkurs. Deutsch Lehrbuch. Hueber. Munichen, 2007.

15LH203 HINDI 3 0 0 3

Course Objectives

- To help students acquire the basics of Hindi language
- To teach them how to converse in Hindi in day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

Course Outcomes (COs)

1. Read and identify Hindi letters, words and simple sentences.
2. Construct simple sentences and use appropriate vocabulary during day-to-day oral communication.

3. Identify basic sounds of Hindi language and understand simple conversations on familiar topics.
4. Write common words and sentences.
5. Comprehend elementary level grammar of Hindi.

UNIT I **9 Hours**

HINDI ALPHABET

Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS IN HINDI

Genders (Masculine & Feminine Nouns ending in a ,e,i,o, u,)- Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

PRONOUNS AND TENSES

Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense -Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Parts of body - Relatives - Spices- Eatables- Fruit & Vegetables - Clothes - Directions-Seasons - Professions.

UNIT V **9 Hours**

SPEAKING

Model Sentences - Speaking practice for various occasions.

Total: 45 Hours

Text Book(s)

1. B. R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.

Reference(s)

1. Syed, PrayojanMulak Hindi, RahamathullahVaniPrakasan, New Delhi, 2002.
2. Ramdev, VyakaranPradeep, SaraswathiPrakasan, Varanasi, 2004.

15LJ203 JAPANESE 3 0 0 3

Course Objectives

- To help students learn Japanese alphabet.
- To teach students how to use the basic Japanese sentences in day-to-day conversation.
- To make students familiar with the Japanese cultural facets and social etiquettes.

Programme Outcomes (POs)

Course Outcomes (COs)

1. Recognise and write Japanese alphabet.
2. Speak using basic sounds of the Japanese language.
3. Apply appropriate vocabulary needed for simple conversation in Japanese language.

4. Apply appropriate grammar to write and speak in Japanese language.
5. Comprehend the conversation and give correct meaning.

UNIT I **9 Hours**

UNIT 1

Introduction to Japanese - Japanese script - Pronunciation of Japanese(Hiragana) - Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 des - N1 wa N2 ja arimasen - S ka - N1mo - N1 no N2 - .san - Kanji - Technical Japanese Vocabulary (25 Numbers) - Phonetic and semantic resemblances between Tamil and Japanese.

UNIT II **9 Hours**

UNIT 2

Introduction - Kore - Sore - are - Kono N1 - Sono N1 - ano N1 - so des - so ja arimasen - S1 ka - S2 ka - N1 no N1 - so des ka ' koko - soko - asoko - kochira - sochira - achira - N1 wa N2 (Place) des - dhoko-N1 no N2 - Kanji-10 - ima-.ji-fun des - Introduction of verb - V mas - V masen - V mashitha - V masen deshitha - N1(Time) ne V - N1 kara N2 des - N1 tho N2 / S ne Kanji-10 - Technical Japanese Vocabulary (25 Numbers) - Dictionary Usage.

UNIT III **9 Hours**

UNIT 3

- N1(Place) ye ikimas - ki mas - kayerimasu - Dhoko ye mo ikimasen - ikimasendheshitha - N1(vehicle) de ikimasu - kimasu - kayerimasu - N1(Personal or Animal) tho V ithsu - S yo. - N1 wo V (Transitive) - N1 wo shimus - Nani wo shimasu ka - Nan & Nani - N1(Place) de V - V masen ka - V masho - Oo. Kanji-10 , N1(tool - means) de V - Word / Sentence wa go nan des ka - N1(Person) ne agemus - N1(Person) ne moraimus - mo V shimashitha - , Kanji-10 - Japanese Typewriting using JWPCE Software, Technical Japanese Vocabulary (25 Numbers).

UNIT IV **9 Hours**

UNIT 4

Introduction to Adjectives - N1wanaadj des. N1 wa ii adj des - naadjna N1 - ii adj ii N1 - Thothemo - amari - N1 wadho des ka - N1 wadhonna N2 des ka - S1 ka S2 - dhore - N1 gaarimasu - wakarimasu - N1 ga suki masu - N1 gakiraimasu - jozu des - hetha des - dhonna N1 - Usages of yoku - dhaithai - thakusan - sukoshi - amari - zenzen - S1 kara S2 - dhoshithe, N1 gaarimasu - imasu - N1(Place) ne N2 gaarimasu - iimasu - N1 wa N2(Place) ne arimasu - iimasu - N1(Person,Place,or Thing) no N2 (Position) - N1 ya N2, Kanji-10 - Japanese Dictionary usage using JWPCE Software, Technical Japanese Vocabulary (25 Numbers).

UNIT V **9 Hours**

UNIT 5

Saying Numbers , Counter Suffixes , Usages of Quantifiers -Interrogatives - Dhonokurai - gurai - Quantifier-(Period) ne -.kai V - Quantifier dhake / N1 dhake Kanji - Past tense of Noun sentences and na Adjective sentences - Past tense of ii-adj sentences - N1 wa N2 yoriadj des - N1 tho N2 tho Dhochiragaadj des ka and its answering method - N1 [no naka] de {nani/dhoko/dhare/ithsu} ga ichiban adj des ka - answering -N1 gahoshi des - V1 mas form dhake mas - N1 (Place) ye V masu form ne ikimasu/kimasu/kayerimasu - N1 ne V/N1 wo V - Dhokoka - Nanika - gojumo - Technical Japanese Vocabulary (25 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

2. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Software 1. Nihongo Shogo-1 2. Nihongo Shogo-2 3. JWPCE Software 3. JWPCE Software
2. 1. www.japaneselifestyle.com 2. www.learn-japanese.info/ 3. www.kanjisite.com/ 4. www.learn-hiragana-katakana.com/typing-hiragana-characters/

PHYSICS ELECTIVE

15PH201 PHYSICS OF MATERIALS 3 0 2 4

Course Objectives

- Understand the physical properties of conductors, semiconductors and superconductors
- Recognize the basic principles of interaction of light with matter and working of optical devices
- Classify the types of dielectric, magnetic materials and polarization mechanisms with their properties

Programme Outcomes (POs)

Course Outcomes (COs)

1. Analyze the properties of conductors and superconductors for different applications
2. Apply the concepts and types of semiconductors for solar cell applications
3. Discuss the types, properties and applications of dielectric materials
4. Explain the properties of optical materials, working mechanism of LEDs and LCDs
5. Classify the magnetic materials with their properties and apply in the data storage devices

UNIT I **9 Hours**

CONDUCTING AND SUPERCONDUCTING MATERIALS

Electrical and thermal conductivity of metals - Wiedemann Franz law - band theory of metals - density of states. Superconductors: properties - types - High Tc superconductors- applications.

UNIT II **10 Hours**

SEMICONDUCTORS

Elemental and compound semiconductors - intrinsic semiconductors: carrier concentration - electrical conductivity- band gap. Extrinsic semiconductors: carrier concentration - variation of Fermi level. Hall effect: theory and experimental determination -applications:Solar cells

UNIT III **9 Hours**

DIELECTRIC MATERIALS

Types of polarization: electronic, ionic, orientation and space charge polarization mechanisms - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric strength and loss -dielectric breakdown mechanisms - active dielectric materials: pizo, pyro and ferroelectricity - applications.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Interaction of light with materials - optical absorption - transmission - Luminescence in solids - Fluorescence and Phosphorescence - Optical band gap - LED ,LCD.

UNIT V **8 Hours**

MAGNETIC MATERIALS

Classification and properties - domain theory - hard and soft magnetic materials - anti-ferro and ferri magnetic materials - applications: magnetic recording and memories.

FOR FURTHER READING

Photonic crystals – LIFI

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of travelling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13th revised edition, Meerut, India, 2013.
2. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
3. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
4. M.A. Wahab, N.K. Mehta, Solid state physics-structure and properties of materials, Narosa publishing house Pvt. Ltd, 6th edition, 2010.
5. Semiconductor Physics and Devices, Donald A. Neamen , Mc Graw-Hill, 2011.
6. P.K. Palanisamy, Materials Science, Scitech Publications India Pvt. Ltd, 2014.

15PH202 APPLIED PHYSICS 3 0 2 4

Course Objectives

- Understand conducting, semiconducting, dielectric and magnetic properties of materials and exemplify their applications
- Analyze the basic concepts of thermodynamics and heat transfer with illustrations
- Gain knowledge about acoustical standards of buildings

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyze the physical properties of conducting and semiconducting materials
2. Discuss the physical properties of dielectric and magnetic materials with their applications
3. Apply the thermodynamic processes and laws to compute the efficiency of heat engines
4. Compare the different heat transfer modes with real time applications of conduction
5. Explain the characteristics of music and select proper sound absorbing materials for good acoustic of buildings

UNIT I **11 Hours**

CONDUCTORS AND SEMICONDUCTORS

Conductors: Classical free electron theory - electrical and thermal conductivity- Wiedemann - Franz law - merits and demerits of classical free electron theory - band theory - density of states. Semiconductors: Elemental and compound semiconductors - intrinsic semiconductors -Fermi level and electrical conductivity - band gap energy - extrinsic semiconductors - n-type and p-type semiconductors: variation of Fermi level with temperature (qualitative) - Hall effect - applications.

UNIT II **9 Hours**

DIELECTRIC AND MAGNETIC MATERIALS

Dielectrics: Fundamental terminologies - electronic and ionic polarizations - orientation polarization mechanism (qualitative) - space charge polarization - Langevin -Debye equation - dielectric loss - applications of dielectric and insulating materials.
Magnetic Materials: Properties of dia, para and ferromagnetic materials - domain theory of ferromagnetism - hysteresis curve - hard and soft magnetic materials - applications

UNIT III **9 Hours**

THERMODYNAMICS

Zeroth law of thermodynamics - Heat - equilibrium and quasistatic process - path functions - comparison between heat and work - internal energy - first law of thermodynamics - isothermal and adiabatic process - work done - reversible and irreversible process - second law of thermodynamics - entropy - enthalpy - Carnot ideal engine and its efficiency - Carnot's theorem-actual heat engine: Diesel engine and its efficiency

UNIT IV **9 Hours**

HEAT TRANSFER

Modes of heat transfer - thermal conductivity - heat capacity and diffusivity - rectilinear flow of heat - conduction through bodies in series and parallel - determination of thermal conductivity: good conductor: Searle's method - bad conductor: Lee's disc method - applications of heat transfer: formation of ice in ponds - conductivity of earth's crust and age of earth - practical applications

UNIT V **7 Hours**

ACOUSTICS

Classification of sound based on frequency - characteristics of audible sound - reverberation time: Sabine's formula - determination of absorption coefficient - Erying's formula (qualitative). Sound insulation - sound absorbing materials - factors affecting the acoustics of building - remedies

FOR FURTHER READING

Nanomaterials and its applications

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons,Inc, 2010
2. BrijLal, N. Subrahmanyam and P. S. Hemne, Heat, Thermodynamics & Statistical Physics, S. Chand & Company Ltd., New Delhi, 2012
3. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13threvised edition, Meerut, India, 2013
4. P.K. Mittal, Applied Physics, I.K. International Publishing House Pvt. Ltd, 2008
5. Donald A. Neamen, Semiconductor Physics and Devices,McGraw-Hill, 2011

15PH203 MATERIALS SCIENCE 3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To impart fundamental knowledge in optical materials
- To understand the nature and applications of different magnetic materials

Programme Outcomes (POs)

Course Outcomes (COs)

1. distinguish electrical properties of different kinds of conducting materials
2. identify the different types of semiconductors and its applications
3. categorize the various polarization mechanisms in dielectrics
4. choose the suitable material for the construction of display devices
5. select appropriate magnetic materials for magnetic storage devices

UNIT I **8 Hours**

ELECTRICAL PROPERTIES OF METALS

Quantum free electron theory: Fermi-Dirac distribution function - Fermi energy and its variation with temperature - density of energy states - calculation of density of electrons and fermi energy at 0K - mean energy of electrons at 0K - problems.

UNIT II **10 Hours**

SEMICONDUCTING MATERIALS

Introduction - elemental and compound semiconductors - intrinsic semiconductors: expressions for number of electrons and holes - determination of carrier concentration and position of Fermi energy - electrical conductivity - band gap energy determination - carrier concentration in extrinsic semiconductors. Hall effect: theory and experimental determination - uses - problems.

UNIT III **9 Hours**

DIELECTRICS

Introduction - fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin - Debye equation - frequency and temperature effects on polarization - internal field - expression for internal field (cubic structure) - Clausius-Mosotti equation and its importance - applications of dielectric materials - problems.

UNIT IV **9 Hours**

OPTICAL MATERIALS

Introduction - optical absorption in metals, semiconductors and insulators. Fluorescence and phosphorescence. Light emitting diode: principle, construction, working and applications. Liquid crystal display: general properties - dynamic scattering display - twisted nematic display - applications - comparison between LED and LCD. Blue ray disc - principle - working.

UNIT V **9 Hours**

MAGNETIC MATERIALS

Introduction - orbital and spin magnetic moments - Bohr magneton - basic definitions - classification of magnetic materials - domain theory of ferromagnetism - process of domain magnetization - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials.

FOR FURTHER READING

Optical data storage and Giant magnetoresistance

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and Sons, Inc, 2010.
2. S.O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2014.
3. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
4. P.K. Palanisamy, Physics For Engineers, Scitech Publications (India) Pvt. Ltd., Chennai, 2010.
5. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, New Delhi, 2010.
6. R.K.Gaur and S.L.Gupta, Engineering Physics, Dhanpat Rai publications, New Delhi, 2010.

15PH204 PHYSICS OF ENGINEERING MATERIALS 3 0 2 4

Course Objectives

- To familiarize with the physical properties of materials
- To gain practical applications of modern spectroscopy and microscopy techniques
- To understand the preparation of bio and nanomaterials

Programme Outcomes (POs)

Course Outcomes (COs)

1. identify the electrical and thermal properties of conducting and semiconducting materials
2. analyze the various polarization mechanisms in dielectrics
3. choose specific materials for optical and magnetic data storage devices
4. investigate the specimen with the aid of suitable spectroscopic techniques
5. realize the methods adopted for preparing nano materials

UNIT I **10 Hours**

CONDUCTING AND SEMICONDUCTING PROPERTIES

Quantum free electron theory - Fermi-Dirac distribution function - effect of temperature on Fermi function - density of energy states - calculation of density of electrons and Fermi energy at 0 K. Intrinsic semiconductors: expressions for density of electrons and holes - intrinsic carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in n-type and p-type semiconductors - variation of Fermi level with temperature and impurity concentration - problems.

UNIT II **9 Hours**

DIELECTRIC PROPERTIES

Introduction: fundamental definitions in dielectrics - types of polarization - expressions for electronic and ionic polarization mechanisms - orientation polarization (qualitative) - Langevin-Debye equation - frequency and temperature effects on polarization - dielectric loss - dielectric breakdown mechanisms - active dielectric materials - applications of dielectric materials - problems.

UNIT III **10 Hours**

OPTICAL AND MAGNETIC PROPERTIES

Optical properties: introduction - light interaction with solids - atomic and electronic interactions - optical properties of metals, semiconductors and insulators - reflection - refraction - absorption - transmission - luminescence and photoconductivity. Magnetic properties: introduction - origin of magnetic moment - properties of dia, para and ferro magnetic materials - domain theory and hysteresis effect - hard and soft magnetic materials - problems.

UNIT IV **8 Hours**

SPECTROSCOPY AND MICROSCOPY TECHNIQUES

Introduction: different types of spectroscopy techniques - basic principle of FTIR spectroscopy and X-ray Photoelectron Spectroscopy (XPS). Basic principle and working mechanisms of Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - Atomic Force Microscope (AFM).

UNIT V **8 Hours**

BIO AND NANO MATERIALS

Biomaterials: classification of biomaterials - development of biomaterials - applications. Nanomaterials: properties - synthesis of nanomaterials - top-down approach: ball milling technique - bottom-up approach: Chemical Vapour Deposition (CVD) - uses of nanomaterials. Carbon nanotubes: properties and applications.

FOR FURTHER READING

Health and environmental impacts

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. William D. Callister, Materials Science and Engineering An Introduction, John Wiley and Sons, Inc, 2010.
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
3. Jacob Milliman, Christos Halkias, Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
4. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
5. Subbiah Pillai, Nanobiotechnology, MJP Publishers, 2010.
6. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley-VCH, 2013.

15PH205 SOLID STATE PHYSICS 3 0 2 4

Course Objectives

- To explain the properties of conducting, semiconducting and dielectric materials
- To understand the working mechanism of junction diodes
- To impart knowledge in optical and magnetic materials

Programme Outcomes (POs)

Course Outcomes (COs)

1. identify different types of emission of electrons and significance of Fermi function
2. explore the carrier concentration and its variation with temperature of different semiconducting materials
3. analyze the I-V characteristics of a junction diode
4. investigate the various polarization mechanisms in dielectrics
5. select appropriate optical and magnetic materials for data storage devices

UNIT I **10 Hours**

EMISSION PROPERTIES AND QUANTUM THEORY OF SOLIDS

Emission of electrons: types thermionic emission-principle- Richardson equation- secondary emission- principle- work function- Fermi-Dirac distribution function and its temperature dependence significance of Fermi energy- density of energy states- calculation of density of electrons and Fermi energy at 0K- average energy of electrons at 0K problems.

UNIT II **9 Hours**

SEMICONDUCTOR PHYSICS

Intrinsic semiconductors: the law of mass action - expressions for density of electrons and holes - determination of carrier concentration - band gap energy. Extrinsic semiconductors: carrier concentration in p-type and n-type semiconductors. Hall effect: theory - experimental determination of Hall voltage - applications - problems.

UNIT III **9 Hours**

JUNCTION DIODE CHARACTERISTICS

Introduction - pn junction diode - volt-ampere characteristics - diode current equation - static and dynamic resistances - space charge - diffusion capacitance - junction diode switching times. Diode circuit with DC voltage source. Applications: full wave rectifier - capacitor filters - clamper circuits.

UNIT IV **9 Hours**

DIELECTRICS

Introduction: fundamental definitions in dielectrics - expressions for electronic and ionic polarizations - orientation polarization (qualitative) - space charge polarization - Langevin Debye equation - frequency and temperature effects on polarization - expression for internal field (cubic structure) - Clausius-Mosotti equation - dielectric loss - applications of dielectrics - problems.

UNIT V **8 Hours**

OPTOELECTRONICS AND MAGNETIC MATERIALS

Principle, working and characteristics of LED and LCD - blue ray disc. Magnetic materials: basic definitions - properties of dia, para and ferro magnetic materials - explanation of hysteresis curve based on domain theory - hard and soft magnetic materials. Magnetic storage device: principle - working - giant magnetoresistance.

FOR FURTHER READING

Motion of an electron in uniform and non-uniform magnetic fields - electric and magnetic fields in a crossed configuration.

1 **2 Hours**

INTRODUCTION

Exposure to Engineering Physics Laboratory and precautionary measures

2 **4 Hours**

EXPERIMENT 1

Using Lees disc apparatus, determine the coefficient of thermal conductivity of a bad conductor.

3 **4 Hours**

EXPERIMENT 2

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor.

4 **4 Hours**

EXPERIMENT 3

With the aid of traveling microscope, find the refractive index of a transparent solid and liquid material.

5 **4 Hours**

EXPERIMENT 4

Determine the wavelength of polychromatic source in the visible region using spectrometer.

6 **4 Hours**

EXPERIMENT 5

Based on Hall effect, calculate the charge carrier density of a given semiconductor and identify the nature of the semiconductor.

7 **4 Hours**

EXPERIMENT 6

Draw the B-H curve of a ferromagnetic material subjected to external magnetic field and hence identify the nature of the material.

8 **4 Hours**

EXPERIMENT 7

Determine the V-I characteristics of a solar cell.

Total: 75 Hours

Reference(s)

1. Jacob Millman, Christos Halkias and Satyabrata JIT, Electronic Devices and Circuits, McGraw Hill Education (India) Private Limited, New Delhi, 2014.
2. William D. Callister, Materials Science and Engineering an Introduction, John Wiley and sons, Inc, 2010.
3. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011.
4. R. S. Sedha, A textbook of Applied Electronics, S. Chand & Company Ltd., New Delhi, 2010.
5. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010
6. M. N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.

CHEMISTRY ELECTIVE

15CH201 ENGINEERING CHEMISTRY 3 0 2 4

Course Objectives

- Recall the terminologies of electrochemistry and explain the function of batteries and fuel cells with its electrochemical reactions
- understand the fundamentals of corrosion, its types and polymers with its applications
- choose appropriate instrumentation technique for interpreting analytical data

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. construct an electrochemical cell and measure its potential using selected reference electrode
2. identify the electrodes, electrolyte and cell reactions in batteries, fuel cells and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Analyze the type of corrosion, factors influencing rate of corrosion on metals and identify suitable corrosion control method
4. differentiate polymers based on its source, properties and applications
5. Select suitable analytical method for the estimation of alkali and alkaline earth metals in aqueous media

Articulation Matrix

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

UNIT I **10 Hours**

INTRODUCTION TO ELECTROCHEMISTRY

Types of electrodes - electrode potential - salt bridge - cell reaction - cell representation - silver-silver chloride electrode - calomel electrode - determination of single electrode potential - electrochemical series and its importance. Ion-selective electrode: glass electrode - measurement of pH using glass electrode. Concentration cells (electrode and electrolyte). Potentiometry - potentiometric titrations (redox titration). difference between electrochemical and electrolytic cells

UNIT II **9 Hours**

ENERGY STORAGE DEVICES

Batteries - characteristics of battery - types of batteries. construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Comparison with conventional galvanic

cells. Fuel cells - Types of fuel cells: solid polymer electrolyte fuel cell - solid oxide fuel cells - microbial fuel cell. Hydrogen-oxygen fuel cell - construction, working, advantages and limitations

UNIT III **8 Hours**

CORROSION SCIENCE

Corrosion: definition - types of corrosion: chemical and electrochemical corrosion - Pilling-Bedworth ratio - types of oxide layer (stable, unstable, volatile and porous) - hydrogen evolution and oxygen absorption mechanism for electrochemical corrosion - mechanism for rusting of iron. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, waterline and pipeline). Galvanic series - applications. Factors influencing corrosion: nature of metal and environment. Corrosion control methods: sacrificial anode method - impressed current cathodic protection method - electroplating - electroless plating

UNIT IV **10 Hours**

POLYMERS AND ITS PROCESSING

Advantages of polymers over metals. Monomers - polymers - polymerization - functionality - degree of polymerization - classification of polymers based on source and applications - Molecular weight determination. Types of polymerization: addition, condensation and copolymerization - mechanism of free radical polymerization. Preparation, properties and applications of thermosetting (epoxy resin and bakelite) and thermoplastics (polyvinyl chloride and polytetrafluoroethylene). Compounding of plastics - injection and extrusion moulding methods

UNIT V **8 Hours**

INSTRUMENTATION TECHNIQUES FOR CHEMICAL ANALYSIS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: UV-visible spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of a transition metal) - Flame photometry (estimation of an alkali metal)

FOR FURTHER READING

Nobel prize winners in chemistry over past 5 years

1 **2 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and M/10 sodium carbonate solution.

2 **4 Hours**

EXPERIMENT 2

Determination of strength of hydrochloric acid present in the given solution by pH measurement.

3 **4 Hours**

EXPERIMENT 3

Determination of strength of HCl by conductometric titration.

4 **4 Hours**

EXPERIMENT 4

Conductometric titration of mixture of acids (Hydrochloric acid and acetic acid).

5 **4 Hours**

EXPERIMENT 5

Estimation of iron in the given sample by potentiometric method using saturated calomel electrode.

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on zinc/mild steel in aerated neutral/acidic/alkaline solution by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method.

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012.
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008.
5. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.

15CH202 APPLIED CHEMISTRY 3 0 2 4

Course Objectives

- understand the necessity of water softening processes
- aware the causes and consequences of corrosion
- acquaint the applications of alloying and phase rule in metallurgy
- recognise the fundamentals and applications of fuels
- characterize the chemical compounds using analytical techniques.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. attribute the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. Analyze the type of corrosion, factors influencing rate of corrosion on metals and corrosion control methods
3. Differentiate ferrous and non ferrous alloys based on its properties, applications and illustrate the importance of phase rule in the field of mettallurgy
4. Distinguish the three types of fuels based on calorific value for selected applications

5. Apply suitable analytical methods for the estimation of elements in aqueous media

Articulation Matrix

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

UNIT I **10 Hours**

WATER PURIFICATION

Hardness of water - classification of hardness (temporary and permanent) - units of hardness (ppm, mg/l, degree Clark, degree French) - expression of hardness in terms of calcium carbonate equivalence - estimation of hardness by EDTA Method - Uses of water for industrial purpose - requirements of boiler feed water - disadvantages of using hard water in industrial boilers: scale, sludge, priming, foaming and caustic embrittlement. Removal of dissolved salts from hard water: internal conditioning (phosphate, carbonate, calgon and colloidal methods), external conditioning (ion exchange process, reverse osmosis, electrodialysis). Uses of water for domestic purpose - municipal water treatment (screening, aeration, coagulation, sedimentation, filtration and disinfection of water - break point chlorination).

UNIT II **8 Hours**

CORROSION SCIENCE

Corrosion - chemical and electrochemical corrosion - Pilling-Bedworth rule - mechanism (types of oxide layer, oxygen absorption - hydrogen evolution) - Galvanic series -types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline and waterline)-Factors influencing corrosion (nature of metal and environment). Corrosion control: sacrificial anode - impressed current method.Protective coatings - paint -constituents and functions.

UNIT III **9 Hours**

ALLOYS AND PHASE RULE

Alloys: purpose of alloying - function and effects of alloying elements - properties of alloys - classification of alloys. Ferrous alloys: nichrome and stainless steel. Non-ferrous alloys: brass and bronze. Heat treatment of alloys (annealing, hardening, tempering, normalising, carburizing and nitriding).

Phase rule: phase - component - degree of freedom - phase rule - phase diagram - applications- one component system (water system). Reduced phase rule - two component system (lead and silver system).

UNIT IV **10 Hours**

FUELS

Classification - characteristics - calorific value - solid fuel - coal - types - analysis of coal (proximate and ultimate analysis) - processing of coal to coke - carbonization - types (low temperature and high temperature carbonization) - manufacture of metallurgical coke (Otto Hoffmann method). Liquid fuels - petroleum - refining of crude oil - knocking - octane number - cetane number. Liquid fuel from coal (Bergius process). Gaseous fuels - natural gas (CNG) - coal gas - producer gas - syn gas - shale gas.

UNIT V **8 Hours**

INSTRUMENTAL METHODS

Beer - Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - Infrared spectroscopy - Atomic absorption spectroscopy - Colorimetry (estimation of transition metal) - Flame photometry (estimation of alkali metal).

FOR FURTHER READING

Synthesis and applications of bio-fuels.

1 **2 Hours**

EXPERIMENT 1

Preparation of N/10 oxalic acid and N/10 sodium carbonate solution.

2 **4 Hours**

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH.

3 **4 Hours**

EXPERIMENT 3

Conductometric titration of mixture of acids (HCl CH3COOH).

4 **4 Hours**

EXPERIMENT 4

Determination of strength of hydrochloric acid in a given solution using pH meter.

5 **4 Hours**

EXPERIMENT 5

Determination of the strength of Fe(II) in the given sample by potentiometric method.

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion on mild steel in aerated / neutral / acidic / alkaline medium by weight loss method.

7 **4 Hours**

EXPERIMENT 7

Estimation of copper content in brass by EDTA method.

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method.

Total: 75 Hours

Reference(s)

1. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010.
2. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013.
3. Willard Merritt and Dean Settle, Instrumental methods of analysis, CBS publishers, Seventh edition, 2012.

4. Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishers New Delhi, 16th Edition, 2013.
5. R. Mukhopadhy and S. Datta, Engineering Chemistry, New age international Pvt. Ltd, New Delhi, 2010.
6. Shashi Chawla, Engineering Chemistry, Dhanpat Rai Publishers New Delhi, 2nd Edition, 2003.

15CH203 APPLIED ELECTROCHEMISTRY 3 0 2 4

Course Objectives

- Understanding the basic concepts of electrochemistry and their application
- Expanding knowledge about corrosion and methods of control
- Gaining information regarding principle, working and application of batteries and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Construct an electrochemical cell and calculate its cell potential.
2. Measure the emf of a cell using different electrodes.
3. Identify the components and processes in batteries and infer the selection criteria for commercial battery systems with respect to different applications.
4. Differentiate types of corrosion and its prevention by suitable techniques.
5. Recognize the importance of fuel cells and solar battery.

Articulation Matrix

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

UNIT I **9 Hours**

FUNDAMENTALS OF ELECTROCHEMISTRY

Introduction - electrical conductance in solution - electrical double layer - electrode potential - importance of electrode potential. Electrochemical cell - standard cell: Weston cadmium cell - Concentration cell: electrode and electrolyte - applications. Applications of electrolytic cells: electrolysis of water, electrolysis of brine and electroplating of copper and gold

UNIT II **9 Hours**

REFERENCE ELECTRODES

Primary and secondary reference electrodes - metal-metal ion electrode, metal-metal insoluble salt electrodes: silver-silver chloride electrode, calomel electrode - ion-selective electrode: glass electrode - measurement of pH of a solution using glass electrode. Quinhydrone electrode: construction -

advantages - limitations. Applications of EMF measurements: Potentiometric titrations: acid-base titration - oxidation-reduction titration - precipitation titration

UNIT III **10 Hours**

ENERGY STORING DEVICES

Types of batteries - alkaline, lead-acid, nickel-cadmium and lithium batteries - construction, working and commercial applications. Electrochemical sensors. Decomposition potential: variation of decomposition potential for different metals - importance of decomposition potential. Over voltage: factors affecting over voltage value. Maintenance and precautions in battery handling

UNIT IV **10 Hours**

CORROSION SCIENCE

Corrosion - causes - dry and wet corrosion - Pilling-Bedworth rule - mechanism (hydrogen evolution and oxygen absorption) - rusting of iron. Galvanic series - applications. Galvanic corrosion - differential aeration corrosion (pitting, waterline and stress) - factors influencing corrosion. Corrosion control - sacrificial anode and impressed current cathodic protection methods - Metallic coatings: chromium plating - nickel plating - galvanizing and tinning

UNIT V **7 Hours**

FUEL CELL AND SOLAR BATTERY

Introduction - types of fuel cell: low, medium and high temperature fuel cell. Hydrogen-Oxygen fuel cell - advantages. Solid polymer electrolyte fuel cell, solid oxide fuel cells, biochemical fuel cell. Solar battery - domestic, industrial and commercial applications. Environmental and safety issues

FOR FURTHER READING

Document the various batteries with its characteristics used in mobile phones and laptops Maintenance free batteries, Battery recycling

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions.

2 **4 Hours**

EXPERIMENT 2

Determination of strength of a commercial mineral acid by conductometric titration.

3 **4 Hours**

EXPERIMENT 3

Electroplating of copper onto a stainless steel object.

4 **4 Hours**

EXPERIMENT 4

Determination of strength of iron in a given solution by potentiometric method.

5 **4 Hours**

EXPERIMENT 5

Determination of amount of hydrochloric acid present in the given sample using pH meter.

6 **4 Hours**

EXPERIMENT 6

Conductometric titration of mixture of acids.

7 **4 Hours**

EXPERIMENT 7

Determination of corrosion inhibition on mild steel using natural inhibitors.

8 **4 Hours**

EXPERIMENT 8

Estimation of barium by precipitation titration.

Total: 75 Hours

Reference(s)

1. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010.
2. B. S. Chauhan, Engineering Chemistry, 3rd Edition, Laxmi Publication Ltd, New Delhi, 2010.
3. B. R. Puri, L. R. Sharma and Madan S Pathania, Principles of physical chemistry, 46th Edition, Vishal publishing Ltd, New Delhi, 2013.
4. B. S. Bahl, G. D. Tuli and Arun Bahl, Essentials of Physical Chemistry, 5th Edition, S. Chand & Company, New Delhi, 2012.
5. S. Vairam, Engineering Chemistry, 1st Edition, John -Willy, India private limited, New Delhi, 2014.
6. Sashi Chawla, Text Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 2010.

15CH204 INDUSTRIAL CHEMISTRY 3 0 2 4

Course Objectives

- impart knowledge on the principles of water characterization, treatment methods and industrial applications
- understand the principles and application of electrochemistry, fuel and combustion
- recognize the fundamentals of polymers, nano chemistry and analytical techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. identify the internal and external treatment methods for the removal of hardness in water for domestic and industrial applications.
2. utilize the concepts of electrochemistry in real time applications.
3. realise the importance of fuel chemistry in day to day life.
4. differentiate the polymers used in day to day life based on its source, properties and applications
5. familiarize with the synthesis and characterization techniques of nanomaterials.

Articulation Matrix

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

UNIT I **10 Hours**

WATER PURIFICATION TECHNOLOGY: SOFTENING AND DESALINATION

Hardness of water: Equivalents of calcium carbonate - Units of hardness - Degree of hardness and estimation (EDTA method). Use of water for industrial purposes: Boiler feed water-scale-sludge - priming and foaming -caustic embrittlement. Softening of hard water: External conditioning - ion exchange methods - Internal conditioning - trisodium, dihydrogen, trihydrogen phosphate and sodium hexameta phosphate- carbonate- colloidal methods. Desalination: Reverse osmosis - electrodialysis. Domestic water treatment - Disinfection of water - break point chlorination

UNIT II **10 Hours**

ELECTROCHEMISTRY

Introduction - EMF - Single electrode potential -Calomel electrode - Glass electrode -pH measurement using glass electrode - Electrochemical series. Cells: Electrochemical cells - Cell reactions- Reversible cells and irreversible cells. Batteries - characteristics of battery - types of batteries, construction, working and applications: Primary (alkaline) and secondary (lead-acid and nickel-cadmium) - Modern batteries (zinc air battery and lithium batteries) - precautions for battery maintenance. Fuel cell: Hydrogen - Oxygen fuel cell.Electroplating of copper and electroless plating of nickel

UNIT III **8 Hours**

FUELS AND COMBUSTION

Fuel: Introduction - classification of fuels - calorific value - higher and lower calorific values - analysis of coal (proximate and ultimate) - carbonization - manufacture of synthetic petrol (Bergius process) - knocking - octane number - cetane number - natural gas - Compressed Natural Gas (CNG)- Liquefied Petroleum Gases (LPG) - producer gas - water gas. Combustion of fuels: introduction- theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - ignition temperature

UNIT IV **9 Hours**

POLYMER AND COMPOSITES

Monomers - functionality - degree of polymerizations - classification of polymers based on source and applications; porosity - tortuosity - molecular weight determination by Ostwald method - polymerization methods: addition, condensation and copolymerization - mechanism of free radical polymerization -thermosetting and thermoplastics. Polymer blends - composites, significance, blending-miscible and immiscible blends, phase morphology, fibre reinforced plastics, long and short fibre reinforced composites

UNIT V **8 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire -nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types -

production - properties - applications. Working principle and applications - Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV-Visible spectrophotometer

FOR FURTHER READING

Application of nanomaterials in medicine, environment, energy, information and communication sectors

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

2 **4 Hours**

EXPERIMENT 2

Water quality of BIT campus - River - Bore well water with respect to hardness, TDS and pH

3 **4 Hours**

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 **4 Hours**

EXPERIMENT 4

Determination of strength of a commercial mineral acid by conductometric titration

5 **4 Hours**

EXPERIMENT 5

Conductometric titration of mixture of acids

6 **4 Hours**

EXPERIMENT 6

Determination of the strength of iron in the given sample by potentiometric method

7 **4 Hours**

EXPERIMENT 7

Determination of molecular weight of polyvinyl alcohol by Ostwald viscometry method

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. A. Pahari and B.Chauhan, Engineering Chemistry, Infinity Science press LLC, New Delhi, 2010
3. P.H. Rieger, Electrochemistry, Springer, Netherland, Second Edition (Reprint) 2012
4. Fred W. Billmeyer JR, Textbook of polymer science, John Wiley & sons, Third edition, 2008
5. G. Cao, Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, World Scientific, New Jersey, 2011
6. S. Sarkar, Fuels and combustion, 3rd edition, Orient Longman Ltd. New Delhi, 2010

15CH205 WATER TECHNOLOGY AND GREEN CHEMISTRY

3 0 2 4

Course Objectives

- Imparting the knowledge on the principles of water technology and green chemistry
- Understanding the principles and applications of green technology in water treatments
- Infer the engineering applications of green chemistry in dyes, corrosion engineering and nanotechnology

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Explain the importance of green chemistry with its emergence and development.
2. Realize the designing of safer methodologies for green technology to meet the objectives of green engineering.
3. Identify the type of corrosion and its mechanism which will help to develop the corrosion control methods.
4. Apply suitable technique to extract natural dye from its source.
5. Familiarize with the synthesis and characterization techniques of nanomaterials.

Articulation Matrix

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

UNIT I **9 Hours**

WATER TREATMENT

Water quality parameters - Hardness of water - Disadvantages of hard water - Degree of hardness and its estimation (EDTA method) - Boiler feed water - Boiler troubles: Priming, foaming and caustic embrittlement - Softening of hard water: Internal conditioning: Sodium hexameta phosphate - Phosphate methods; External conditioning: Ion exchange method - Desalination: Reverse osmosis - Electrodialysis. Domestic water treatment - Disinfection of water - Break point chlorination.

UNIT II **8 Hours**

WASTE WATER ANALYSIS

Basic principles and concept of green chemistry - Need of green chemistry in day-to-day life - Scientific areas for practical applications of green chemistry - Industrial effluents - Waste water analysis: Concept of chemical oxygen demand (COD) and biological oxygen demand (BOD) - Removal of trace pollutants in waste water: Membrane Bioreactor (MBR) technology - Wet oxidation method.

UNIT III **10 Hours**

CHEMISTRY OF CORROSION

Corrosion: Mechanism of corrosion - chemical and electrochemical - Pilling-Bedworth rule - oxygen absorption - hydrogen evolution - galvanic series. Types of corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline, water line and wire fence corrosion) - factors influencing corrosion. Methods of corrosion control: choice of metals and alloys - proper designing - cathodic protection (Sacrificial anode method, impressed current method)-modifying the environment. Protective coatings: Concept of electroplating: electroplating (gold and copper) - electroless plating (nickel and copper).

UNIT IV **9 Hours**

NATURAL DYES

Introduction - definition - classification of natural dyes - concept of chromophores and auxochromes - Extraction process of colour component from natural dyes: Aqueous extraction, non-aqueous extraction - Purification of natural dyes: Chromatography techniques - Types - Column chromatography - thin layer chromatography - Qualitative analysis: UV-Visible spectroscopic study - Mordant: Metallic and non-metallic mordant - advantages and disadvantages of natural dyes.

UNIT V **9 Hours**

NANOMATERIALS

Types of Nanomaterials - Nano particles - nanoclusters - nano rod - nanowire - nano tube. Synthesis: Top down process: laser ablation - electrodeposition - chemical vapor deposition. Bottom up process: Precipitation - thermolysis - hydrothermal - solvothermal process. Carbon nanotubes: Types - production - properties - applications. Working principle and applications: Scanning Electron Microscope (SEM) - Transmission Electron Microscope (TEM) - UV- Visible spectrophotometer. Synthesis of Au and Ag nanoparticles using plant extract - Advantages.

FOR FURTHER READING

Protection of metals in concrete against corrosion
Microwave technology on green chemistry

1 **2 Hours**

EXPERIMENT 1

General instructions to students - Handling reagents and safety precautions

2 **4 Hours**

EXPERIMENT 2

Water quality- river/bore well water with respect to hardness and TDS

3 **4 Hours**

EXPERIMENT 3

Determination of strength of hydrochloric acid in a given solution using pH meter

4 **4 Hours**

EXPERIMENT 4

Estimation of strength of iron by potentiometric method using calomel electrode

5 **4 Hours**

EXPERIMENT 5

Extraction of a natural dye by aqueous extraction method

6 **4 Hours**

EXPERIMENT 6

Measurement of rate of corrosion of mild steel in aerated neutral/acidic/alkaline solution by weight loss measurements/Tafel polarization method

7 **4 Hours**

EXPERIMENT 7

Determination of dye concentration in a given sample by using UV-Visible spectroscopic method

8 **4 Hours**

EXPERIMENT 8

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

Total: 75 Hours

Reference(s)

1. M. Munjal and S.M. Gupta, Wiley Engineering Chemistry, Second edition, Wiley India Pvt. Ltd, New Delhi, 2013
2. V K Ahluwalia, Green Chemistry - Environmentally Benign Reactions, Ane Books Pvt. Ltd., New Delhi, 2nd Edition, 2012
3. Giusy Lofrano, Green Technologies for Wastewater Treatment - Energy Recovery and Emerging Compounds Removal, Springer Dordrecht Heidelberg, New York, London, 2012
4. Ashis Kumar Samanta and Adwaita Konar, Natural Dyes - Dyeing of Textiles with Natural Dyes, Dr.Emriye Akcakoca Kumbasar (Ed.), InTech Publisher, New Delhi, 2011
5. J. C. Kuriacose and J. Rajaram, Chemistry in Engineering & Technology, Vol. 1&2, Tata McGraw-Hill, New Delhi, 2010
6. David Pozo perez, Nanotechnology and Nanomaterials, InTech Publishers, NewDelhi, 2010

DISCIPLINE ELECTIVES

16FD001 MILK AND MILK PRODUCTS TECHNOLOGY

3 0 0 3

Course Objectives

- Know the need and importance of dairy industry
- Understand the processing methods technological aspects of milk and its products
- Study the composition and quality of processed milk and its value added products

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Apply the technological interventions in of processing of milk
2. Determine the physico-chemical and compositional aspects of milk
3. Evaluate the manufacture of different dairy products and the equipment's used.
4. Analyze the importance Fat rich dairy product and its properties
5. Identify fermented dairy products and its quality evaluation

Articulation Matrix

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

UNIT I **5 Hours**

INTRODUCTION

Milk production and consumption- India and Worldwide -Status and scope of dairy industry in India - Fluid Milk - Definition of milk, composition, factors affecting composition of milk, types of milk and nutritive value of milk- Basis for pricing of milk- Good hygienic practice in milk processing: Principal hazards, cleaning and disinfection in a dairy industry, definitions, cleaning and disinfection agents and processes.

UNIT II **6 Hours**

QUALITY ANALYSIS AND EVALUATION

Testing the authenticity of milk and milk products: Detection of foreign fats, milk of other species, water, non-milk proteins. Methods of examination and Quality evaluation, Adulteration and its detection. Microbiology of milk: Milk as a substrate for bacteria, spoilage micro organisms, pathogenic micro organisms, sources of contamination, hygienic measures.

UNIT III **11 Hours**

TYPES OF MILK AND ITS PROPERTIES

Milk processing- Concentrated milk, condensed milk, evaporated milk, UHT processed milk, flavored, sterilized milk, dried milk, Soy milk, Imitation milk, whole and skimmed milk powder - Method of manufacture, packaging and storage, defects and their control. Instantization of milk and milk products, flow ability, dustiness, reconstituability, dispersability, wet ability, sink ability and appearance of milk powders. Judging and grading of milk and its products.

UNIT IV **11 Hours**

FAT RICH DAIRY PRODUCTS

Frozen dairy products- Ice-cream- Kulfi- manufacture, packing and storage. Fat rich dairy products - Cream, ghee and margarine- Method of manufacture, packaging and storage. Cheese byproducts- Casein and its derivatives- Whey powder, protein concentrates and isolate- utilization, Infant milk- production.

UNIT V **12 Hours**

FERMENTED AND INDIGENOUS MILK PRODUCTS

Fermented milk - principles- Processing- practices of manufacture, packaging- storage and marketing Fermented milk products- dahi, cultured butter milk, acidophilus milk, yoghurt, shrikhand and probiotic milk based products. Technology of Indigenous dairy products - Present status, method of manufacture of khoa, burfi, kalakand, gulabjamun, rosogolla, chhana, paneer,, lassi etc.

FOR FURTHER READING

Milk substitutes, Traditional dairy products, Fortification of milk, National and international standards of milk and milk products, Sanitation and Hygiene in dairy industry.

Total: 45 Hours

Reference(s)

1. De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007.
2. Smit, G., Dairy processing - improving quality, Woodhead Publishing, 2003.
3. Walstra P., Geuits T.J., Noomen A., Jellema A. and Van Boekel M.A.J.S., Dairy technology- Principles of milk properties and processes, Marcel Dekker Inc., 1999.
4. Spreer E. Milk and dairy product technology. Marcel Dekker Inc.,1998.
5. J M Warner, Principles of Dairy Processing: Wiley Eastern Ltd. New Delhi, 1976.
6. Robinson R.K. Modern dairy Technology, Vol I Advances in Milk processing

16FD002 CEREAL, PULSES AND OILSEED TECHNOLOGY

3 0 0 3

Course Objectives

- Develop the knowledge in the area of Cereal, pulse and oil seed processing and technology
- Understand the specific aspects of food processing related to these foods
- Understand the application of scientific principles in the processing technologies specific to the materials

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

Articulation Matrix

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

UNIT I **9 Hours**

CEREALS

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, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats- Milling, Oat Products - Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

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

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OIL SEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Ceiling and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

FOR FURTHER READING

Major growing areas of cereals and pulses in India, National and global scenario of millet processing and products, Novel extruded millet and cereal products.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman), Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition, CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

16FD003 CROP PROCESS ENGINEERING 3 0 0 3

Course Objectives

- Study the storage and handling techniques of cereals
- Gain knowledge on processing and milling of pulses
- Understand the post harvest processing on application oriented

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Demonstrate different engineering properties of grains and the method to determine moisture content
2. Select suitable equipment for threshing, cleaning and drying of grains and oilseeds
3. Summarize the operations involved in rice and pulse processing
4. Apply the knowledge on the various storage methods to minimize the loss and extend the shelf life of the grains
5. Use different ways to utilize the waste into useful by products and value added products

Articulation Matrix

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

UNIT I **9 Hours**

ENGINEERING PROPERTIES AND MOISTURE CONTENT

Post harvest losses in field crops - optimum stage of harvest, properties of grains - physical, thermal, electrical and aerodynamic properties, moisture content - measurement - direct and indirect methods - moisture meters, equilibrium moisture content - equilibrium relative humidity, relationship and isotherm models, methods of determination

UNIT II **9 Hours**

THRESHING, SHELLING, CLEANING, GRADING AND DRYING

Threshing - threshers, types, cleaning and grading- principles, types, efficiency of separation, performance index, shelling and decortication - principles, maize sheller, husker sheller, groundnut decorticator and castor sheller, psychrometry - properties of air - water vapour mixture, grain drying - principles, types, heat sources, performance of dryers

UNIT III **9 Hours**

RICE AND PULSES PROCESSING

Rice processing - parboiling, drying, dehusking, polishing, modern rice mill machineries - construction details and adjustments, layout of modern rice mills, manufacture of beaten rice, expanded rice and puffed rice, traditional and improved methods, processes and equipments, material handling equipment - types, construction and working - pulse milling - wet and dry method

UNIT IV **9 Hours**

STORAGE

Storage of food grains - factors affecting storage, traditional methods, types - bag and bulk storage, storage structure, storage losses - estimation, storage of grains in large bins, modified atmosphere storage of grains - facilities, construction, operation and maintenance

UNIT V **9 Hours**

WASTE UTILIZATION

Waste materials, sources and classification - crop residues, farm and industrial wastes and by-products, utilization - production of paper and paperboards, particle board, fuel briquettes - production of fibre, activated carbon, furfural and adhesive from tamarind kernel powder

FOR FURTHER READING

Effect of moisture content on different milling operations, traditional and modern storage structures for grains, Storage of grains - status, opportunities and challenges in india, status of waste utilization in India.

Total: 45 Hours

Reference(s)

1. Chakraverty,A., Post Harvest Technology of cereals, pulses and oilseeds, Third Edition, Oxford & IBH publishing & Co. Pvt. Ltd., New Delhi, 2000
2. Sahay, K.M. and K.K. Singh. Unit operations in Agricultural Processing, Vikas Publishing House Pvt. Ltd., New Delhi, 1994.
3. Henderson, S.M. and R.L.Perry, Agricultural process engineering, John Willey and Sons, New York, 1995.
4. Pande, P.H., Principles of agricultural processing, Kalyani Publishers, Ludhiana, 1994.
5. McCabe, W.L. and J.C.Smith, Unit operations in chemical engineering, McGraw Hill Kogakusha Ltd., Tokyo, 2001.
6. Mohsenin, N.N., Physical properties of plant and animal materials, Gordon and Breach publishers, New York, 1986.

16FD004 MILLING TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the importance, structure and properties of cereals and legumes
- Analyze the traditional and modern milling methods of cereals and legumes
- Evaluate the efficiency of major milling equipment used in modern mills of cereals and legumes

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Assess the structure, nutritional value and storage of cereals and legumes
2. Apply the milling techniques, parboiling methods and equipment used in rice milling
3. Analyze the milling efficiency in milled wheat and corn products
4. Compare the efficiency of dry and wet milling techniques in pulse milling
5. Evaluate the extraction and refining methods of oil from oilseeds

Articulation Matrix

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

UNIT I **7 Hours**

GRAIN PROPERTIES

Importance of cereals and legumes- Grain structure and Composition. Physicochemical properties of grains and nutritional value. Premilling operations of grains. Grading. Storage of grains in relation to maintaining grain quality and types of storage structures. Losses during storage and Prevention methods.

UNIT II **10 Hours**

RICE MILLING

Rice - Structure and nutritional value, Traditional rice milling machineries. Modern Rice milling flow chart, operations and equipments used- Cleaning, Dehusking, Husk and paddy separation, Whitening, Polishing, Bran separation, Grading and Colour sorting. Parboiling- Physicochemical changes during Parboiling and effects on rice quality, Methods of Parboiling. Processed rice products - Rice flour, Puffed rice, Rice flakes, Instant Rice, Fermented Rice Products - Rice, Dosa and Dhokla. Byproducts utilization.

UNIT III **10 Hours**

WHEAT AND CORN MILLING

Wheat: Structure, Composition and nutritional value. Wheat milling operations - Cleaning, conditioning, grinding. Components of wheat mill- Sifters, Roller milling - Break rolls and reduction rolls, purifying. Equipments - Destoner, Entoleters. Parboiling of wheat. Efficiency of milling process. Corn: Structure, Composition and nutritional value. Dry and wet milling of corn -flow sheet, Products from corn milling - corn starch, corn syrup, corn flakes, corn meal, corn oil, corn gluten.

UNIT IV **9 Hours**

PULSE MILLING

Structure and Importance of Pulses. Unit operations of pulse milling. Dehulling losses and effect on nutritive value. Milling Methods of pulses. Problems of Pulse milling industry. Factors affecting Pulse milling outturn. Pulse milling Efficiency.

UNIT V **9 Hours**

OIL SEED MILLING

Oil seed processing- natural sources of oil, Seed composition and nutritive value of oil. Pretreatments before oil extraction- Cleaning, dehulling, Size reduction, flaking, Cooking. Extraction techniques - Ghanies, Screw press, Solvent Extraction. Refining of oil, hydrogenation, winterization. Deoiled seed flour.

FOR FURTHER READING

Millet processing, Infectation control of grains, Waste utilization of Cereals, Pulses and Oilseeds milling

Total: 45 Hours

Reference(s)

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

16FD005 ADVANCED DRYING TECHNOLOGY 3 0 0 3

Course Objectives

- Learn the different drying methods availed for drying of foods
- Know the importance of moisture content and heat transfer in drying
- Design a dryer based on its considerations for thermal, non-thermal and novel drying process

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess the heat transfer characteristics on drying parameters
2. Select appropriate drying methods for drying of perishable and non-perishable
3. Design a dryers based on design considerations and drying phenomena
4. Apply the principles of non-thermal processing and assess its effect on food dehydration
5. Implement a novel drying methods for food preservation

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Heat transfer characteristics of food materials - water activity - sorption isotherm behavior - psychrometry in relation to drying, enthalpy- humidity charts, types of psychrometry representation, mass transfer characteristics - theory of diffusion - enthalpy balance - residence time equation and calculation.

UNIT II **10 Hours**

METHODS OF DRYING

Drying of solid foods - classifications and selection of dryers - theoretical modeling of the drying behavior of droplets in spray dryers - impingement drying - impinging steam dryers - rotary dryers - flash dryers - fluidized bed dryers - vibratory fluidized bed dryers, sprouted bed, agitated fluid bed, centrifugal fluid bed dryer. Heat pump drying - principles, construction and operation.

UNIT III **9 Hours**

DESIGN CONSIDERATIONS OF DRYER

General design considerations - flights design, particle dynamics, kinetic angle of repose, flight and drum holdup - drying phenomena, dryer operation and applications -dryer types - conventional and alternate design - properties of feed, drying rate, design criteria, factors affecting drying rate, feed materials - heat transfer -characteristics and drying models.

UNIT IV **8 Hours**

NON THERMAL PROCESSING OF FOODS

Microwave-convective and dielectric drying - electromagnetic fields - infra-red radiation drying - Electrical resistance heating of foods - Electrically Processed Foods. Effect of heat and ultrasound on microorganisms and enzymes

UNIT V **9 Hours**

NOVEL DRYING METHODS

Special drying techniques - contact-sorption drying - drying on inert particles -pulse combustion drying - drying with induction heating - novel dryers - dehydration of foods using cyclic pressure

FOR FURTHER READING

Heat pump drying, Hybrid drying, Advanced modelling methods, Computational fluid dynamics.

Total: 45 Hours

Reference(s)

1. Arnold Spicer, Advances in pre-concentration and dehydration of foods. Applied science publisher Ltd., London. 1974.
2. Arun S. Mujumdar, Hand Book of Industrial Drying Volume I., Marcel Dekker Inc., NewYork. 1995.
3. Karel,M., O.R.Fennema and D.B.Lund, Principles of Food Science, Part II - Physical principles of food preservation, Marcel Dekker Inc, New York. 1975.
4. Kudra, T and Majumdar, A.S., Advanced Drying Technologies, Marcel Dekker Inc., New York, 2002.
5. Loasecke,H.W.V., Drying and dehydration of Foods, Agrobios, Jodhpur, 2001.

16FD006 EXTRUSION TECHNOLOGY 3 0 0 3

Course Objectives

- Impart knowledge to the students about extrusion technology and its principles
- Understand the classification of extruders according to process and construction
- Develop novel extruded products for commercialization

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Explain and predict the current and future trends of extruders in food industry
2. Assess the pre-conditioning process followed by extrusion
3. Differentiate single and twin screw extruder based on its processing
4. Analyze the characteristics of extruded products
5. Apply the extrusion technologies in development of snack foods

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Extrusion: definition, introduction to extruders and their principles, types of extruders. Extruders in the food industry: History and uses of extruders in the food industry

UNIT II **6 Hours**

PRECONDITIONING

Pre-conditioning of raw materials used in extrusion process, Pre-conditioning operations and benefits of pre-conditioning and devolatilization. Interpreted-flight expanders - extruders, dry extruders

UNIT III **11 Hours**

SINGLE AND TWIN SCREW EXTRUDER

Single screw extruder: Constructional and operational characteristics, principle of working, net flow, factors affecting extrusion process, co-kneaders. Twin screw extruder: counter rotating and co-rotating twin screw extruder. Process characteristics of the twin screw extruder: feeding, screw design, screw speed, screw configurations, die design. Barrel temperature and heat transfer, adiabatic operation, heat transfer operations and energy balances. Problems associated with twin screw extruder.

UNIT IV **10 Hours**

CHARACTERISTICS OF VARIOUS EXTRUDED FOOD PRODUCTS

Rheological properties, textural properties. Sensory characteristics and nutritional value. Chemical and nutritional changes in food during extrusion. Practical considerations in extrusion processing: pre-extrusion processes, cooker extruder profiling. Addition and subtraction of materials, shaping and forming at the die, post extrusion processes.

UNIT V **11 Hours**

APPLICATION

Cold extrusion; extrusion cooking, New extrusion technology for confectionery product; Breakfast cereal products. Breakfast cereals: introduction, type of cooking - High shear cooking process, steam cookers, low shear, low pressure cookers and continuous steam pre-cooking, available brands. Traditional and extrusion methods, classification of breakfast cereals - flaked cereals, oven puffed cereals, gun puffed cereals, shredded products. Texturized vegetable protein: Definition, processing techniques, and foods. Snack food extrusion: Direct expanded (DX) and third generation (3G) Snacks: types, available brands, co- extruded snacks and indirect-expanded products.

FOR FURTHER READING

Extrusion Blow moulding Extrusion cooking - recent developments, methods, equipment, and design criteria of extruders, Extrusion - Retort pouch packaging.

Total: 45 Hours

Reference(s)

1. Richardson P., Thermal Technologies in Food Processing, Wood head Publishers, Cambridge, CRC Press, 2001.
2. Guy R. Extrusion Cooking, Technologies and Applications. Wood head Publishing Limited, Abington, Cambridge, 2001.
3. Fast R.B. and Caldwell E.F. Breakfast Cereals and How they are made. American Association of Cereal Chemists, St. Paul, Minnesota, 2000.
4. Frame N.D. The Technology of Extrusion Cooking, Blackie Academic & Professional, New York. 1994.
5. Harper J.M. Extrusion of Foods. Vol. 1&2, CRC Press, Inc; Boca Raton, Florida. 1991.
6. O'Connor C. Extrusion Technology for the Food Industry. Elsevier Applied Science, New York, 1987.

16FD007 APPLICATION OF NANOTECHNOLOGY AND CRYOGENICS IN FOOD PROCESSING

3 0 0 3

Course Objectives

- Understand the concept of Nanotechnology and nano material synthesis
- Impart knowledge on synthesis and characterization techniques involved in Nanotechnology
- Learn the principle and application of cryogenics in food processing

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Acquire knowledge about current trends and future aspects in the field of Nanotechnology
2. Identify the synthesis methods for the production of nano materials
3. Apply the function of Nanotechnology in Food processing and assess its socio economic issue
4. Differentiate the types of cryogenics based on its applications
5. Apply and analyze the necessitate of cryogenics in food industries

Articulation Matrix

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

UNIT I **9 Hours**

BASICS OF NANOTECHNOLOGY AND NANOSTRUCTURES IN FOOD

Background- Evolution of new technologies in the food sector- Public perception of nanotechnology food products-Properties of nanomaterials - Nanomaterial for food applications-Nano-sized food ingredients and additives in relation to digestion of food-Natural nanostructures in food-Naturally occurring food nano substances and nanostructure-Designing food nanostructures.

UNIT II **9 Hours**

NANOMATERIALS AND SYNTHESIS METHOD

Nanomaterials- Physical properties -mechanical and optical properties- Magnetic and size dependent properties of nanomaterials- Electrical conductivity and photoluminescence properties of nanomaterials- Method of nanomaterials synthesis-mechanical, gas phase and physical vapor deposition-Chemical Synthesis-Nanoparticle size determination by X-ray diffraction technique and dynamic light scattering method for colloidal nanoparticle- Manipulation of nanomaterials by transmission electron microscopy (TEM) and scanning electron microscopy (SEM). Use of Infra red and magnetic resonance spectroscopy in nanoscience.

UNIT III **9 Hours**

APPLICATIONS OF NANOTEECHNOLOGY IN FOOD PROCESSING

Nanotechnology in Food Preservation-Nanoemulsion - Nanodispersions -Nanocapsules -Association colloids - Nanocoatings. Nanostructure multilayer emulsions - Biopolymeric nanoparticles - Nano packaging -Nanoplastic - Nanocomposites - Active packaging - Intelligent packaging - Biodegradable Nano packaging - Nanofibers - Nanosensors. Ethical issues in nanotechnology - socio-economic issues - Benefits, challenges and future of nanotechnology.

UNIT IV **9 Hours**

INTRODUCTION TO CRYOGENICS

Cryogenics and its applications- Properties of cryogenic fluids- Properties of materials at cryogenic temperature- Gas-Liquefaction and Refrigeration Systems- Gas Separation- Cryocoolers- Cryogenic Insulations- Vacuum Technology- Instrumentation in Cryogenics- Liquid storage and transfer systems- Cryostat design- Dilution Refrigerator and Adiabatic Demagnetization

UNIT V **9 Hours**

APPLICATIONS OF CRYOGENICS IN INDUSTRIES

Advances in Cryogenics- Vortex tube and applications- Pulse tube refrigerator- Cryogenic Engine for space vehicles- Cryogenic Applications- gas industry- cryogenic fluids- space research- Cryobiology- food processing- chemical processing- cryogenic power generation, medicine, analytical physics and chemistry.

FOR FURTHER READING

Nanotechnology and Food Allergy, Nano-Ethics, Physics of Bionanotechnology, Nanoparticles in Food Diagnostics. **Total: 45 Hours**

Reference(s)

1. Kenneth David & Paul Thompson. What Can Nanotechnology Learn From Biotechnology, ISBN, 2008
2. Qasim chaudhry, Laurence castle and Richard Watkins.. Text book on Nanotechnologies in food, RSC Nano science and Nano technology, published by the Royal society of chemistry, ISBN 978-0-85404-169-5, 2010
3. RE hester and R.M Harrison.. Nanotechnology, Consequences for Human Health and the Environment, ISBN: 978-0-85404-216-6, 2007

4. Peter JM Bartos, John J Hughes, Pavel Trtik.. Nanotechnology in construction, ISBN: 978-0-85404-623-2, 2004
5. Randall F. Barron, Cryogenics Systems, Second Edition Oxford Univesity Press New York, Clarendon Press, Oxford, 1985.
6. Timmerhaus, Flynn, Cryogenics Process Engineering , Plenum Press, New York

16FD008 RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS **3 0 0 3**

Course Objectives

- Identify the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing
- Understand the effect of radiation as a processing and preservation method
- Learn the importance and safety issues of the irradiated foods

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Explain and apply the concept of Radiation chemistry on food preservation
2. Analyze the effect of dosage of radiation on plant and animal foods
3. Exemplify and analyze the effect of microwave in food processing
4. Analyze the effect of Infra-red radiation in food processing
5. Justify and assess the effect of radio frequency on foods

Articulation Matrix

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

UNIT I **9 Hours**

BASICS OF RADIATION CHEMISTRY

Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods

UNIT II **9 Hours**

RADIATION CHEMISTRY OF FOOD COMPONENTS

Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues

UNIT III **9 Hours**

MICROWAVES IN FOOD PROCESSING

Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures

UNIT IV **9 Hours**

INFRA RED RADIATION

Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits

UNIT V **9 Hours**

RADIO FREQUENCY HEATING PRINCIPLES

RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment

FOR FURTHER READING

Black body radiation, Absorption of radiation, Radiation heat transfer, Laws in radiation, ionizing radiation.

Total: 45 Hours

Reference(s)

1. Welter M. Urbain: Food Irradiation Academic Press, New York, 1986.
2. Ohlsson and Bengtson, Microwave Processing Technologies Woodhead Publishing, Cambridge, UK, 2002
3. Gould G.W., New Methods of Food Preservation, Aspen Publishers Inc., Maryland, 1999.
4. S.G.Llyasor and V.V. Krasnikov, Physical Principles of Infra Red Irradiation of Food Stuffs: Hemisphere Publishing Corporation, London, 1991.
5. Philip Richardson, Thermal Technologies for Food Processing, Wood head Publishing Limited, CRC Press, 2001.
6. Robert V. Decareau, Microwave Foods, New Product Development Food & Nutrition Press Inc., USA, 1992.

16FD009 FOOD COLORS AND FLAVOR TECHNOLOGY

3 0 0 3

Course Objectives

- To analyse different food colors and application in food formulations
- To understand different food flavors and its applications
- To know the quality control techniques and regulations involved in colors and flavors

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Identify the synthetic and natural colors and its regulations
2. Evaluate the properties and the importance of colors in food industry
3. Classify the food flavours and its stability.
4. Determine the recent developments of application of flavor in food industry
5. Analyze the methods of estimation of colors and flavors in foods

Articulation Matrix

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

UNIT I **9 Hours**

FOOD COLOURS FOOD COLOURS

Introduction - Natural and Synthetic food Colours - Class and description of food colours -Physical form of food colours - Stability, storage and solubility of food colours -Regulations and safety assessment - Labeling requirements for food containing colour additives -Adulteration and misbranding of colour additives in foods.

UNIT II **7 Hours**

PROPERTIES AND ANALYSIS OF FOOD COLOURS

Food colour stability, Importance of food colours for food products - Methods of analysis for food colour - Quality and safety assessment - Applications of natural and synthetic food colours.

UNIT III **12 Hours**

FOOD FLAVOURS

Introduction - Classification - flavor forms: water soluble liquid flavours - oil soluble liquid flavours, emulsion based flavours, dispersed flavours, spray dried flavours -commercial considerations - Flavor characteristics - Flavor compounds - Natural and artificial flavoring materials - Flavoring constituent of various foods like meat, fish, milk, vegetables, fruits, fats & oils, spices & herbs, cereals and pulses. Changes in flavouring components and characteristics during cooking/processing of various foods. Effects of storage, processing, transportation and environmental conditions on flavour components/constituents.

UNIT IV **9 Hours**

FOOD FLAVOR: APPLICATIONS AND RECENT DEVELOPMENT

Culinary and Meat Products, bakery products, snack foods, sugar based confectionary products, dairy products and soft drinks - Changes in food flavor due to processing -flavor release from foods - Factors that affect the flavour and control of flavour in processed foods. Recent developments in flavour research, processing and technology.

UNIT V **8 Hours**

FOOD FLAVOR: QUALITY CONTROL

Flavouring and coating technologies for preservation and processing of foods. Natural flavor enhancers for food and beverage, Quality Control - analytical, sensory and adulteration testing. Measurement of flavour, particularly for wine, tea, coffee, species and condiments.

FOR FURTHER READING

Roles as sulfur compounds, fatty acids, amino acids, terpenoids, lactic acid, ethanol in food flavours. Spices and herbs as food flavorings.

Total: 45 Hours

Reference(s)

1. Spices and Flavor Technology. J.S. Pruthi, ICAR Publications, 2nd Edition, 1998
2. Fenaroli, G, Handbook of flavour ingredients, CRC Press. Bota Rica, New York, 2005
3. Yamanishi, T, Recent advances in flavour researches, Dekker, New York, 2005
4. Andrew J. Taylor and Robert S. T. Linforth, Food Flavour Technology, Blackwell Publishing Ltd, 2010.
5. Suvendu Bhattacharya, Conventional and Advanced Food Processing Technologies, Wiley Publishers, 2015
6. Heath, HB, Flavour chemistry and technology, CBS Publ., New Delhi, 2005.

16FD010 BEVERAGE PROCESSING 3 0 0 3

Course Objectives

- To understand the classification of beverages
- To impart knowledge and skills of beverage processing techniques
- To understand the quality aspects of beverages

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Organize the formulation of beverages using selected ingredients
2. Apply Unit operations involved in the carbonated beverage manufacturing
3. Explain the various production techniques in non-carbonated beverages
4. Evaluate the quality parameters of fermented beverages
5. Implement the food laws and regulations of beverages

Articulation Matrix

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

UNIT I **10 Hours**

INGREDIENTS IN BEVERAGES

Beverage: Introduction, Global and Indian scenario. Classification of beverages. Ingredients- water, quality evaluation, raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, Micro and nano-emulsions of flavors, colours' natural and artificial, preservatives, clouding agents emulsifiers and stabilizers.

UNIT II **9 Hours**

CARBONATED BEVERAGES

Preparation of Syrup making, blending, Carbonation of soft drinks, filling, packaging, containers, closures. Powdered dry mix; Energy drinks and sports drinks; Fruit based carbonated beverages, carbonated water. Equipments used in the manufacture of carbonated beverages.

UNIT III **10 Hours**

NON-CARBONATED BEVERAGES AND BOTTLED WATER

Beverages based on tea, coffee, cocoa, spices, herbs, dairy based beverages, Fruit based non carbonated beverage - RTS beverages, Squash, Nectar, Cordial and Fruit concentrate. Flash pasteurization, Canning and Aseptic Packaging of beverages. Bottled water, mineral water, spring water, flavored water.

UNIT IV **9 Hours**

FERMENTED BEVERAGES

Alcoholic beverages- Classification. Fermented alcoholic beverage - Beer - ale type beer, lager type beer, the role of yeast in beer, technology of brewing process. Wine, Cider, Perry and Sake. Distilled spirits - Whisky, Brandy, Vodka, Rum, Tequila and gin. Equipment used for brewing and distillation

UNIT V **7 Hours**

SANITATION AND QUALITY CONTROL

Quality control in beverage industry- System quality control Product quality control and microbial quality control. CIP. Sanitation and hygiene in beverage industry. Standards and regulations of beverages.

FOR FURTHER READING

Traditional natural beverages. Raw materials, quality and technology for producing Wine, Beer, Whiskey, Brandy, and Rum. Tea and Coffee processing.

Total: 45 Hours

Reference(s)

1. L.Jagan Mohan Rao and K.Ramalakshmi, Recent trend in Soft beverages, Woodhead Publishing India Pvt Ltd.,New Delhi 2011
2. Woodroof, Jasper Guy, and G. Frank Phillips. Beverages: carbonated and noncarbonated. AVI Pub. Co., 1981
3. Mitchell, Alan J. Formulation and Production Carbonated Soft Drinks. Springer Science & Business Media, 1990
4. Richard Coles and Mark Kirwan Food and Beverage Packaging Technology Second Edition Blackwell Publishing Ltd., 2011.
5. Hui, Yiu H., et al., eds. Handbook of food and beverage fermentation technology. Vol. 134. CRC Press, 2004.
6. Boulton, Christopher, and David Quain. Brewing yeast and fermentation. John Wiley & Sons, 2008.

16FD011 SUGAR TECHNOLOGY 3 0 0 3

Course Objectives

- Understand important unit operations involved in sugarcane processing
- Know the production of sugar from sugarcane, beet and palm
- Explore the large scale processing of sugar from sugarcane

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Identify the suitable machineries for pre-processing and transportation of sugarcane
2. Select appropriate crushers for cane juice extraction and determine its efficiency
3. Assess the cane juice clarification using different clarifying agents
4. Explain and apply the filtration and evaporation in sugarcane processing
5. Attribute crystallization for the large scale production of sugar

Articulation Matrix

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

UNIT I **9 Hours**

PRE PROCESSING OPERATIONS

Sugarcane - Constituents - Harvesting indices - Cane cutting - Manual, Mechanical - Transportation - loading - Unloading - Cane conveyor - Washing - Shredders - Types.

UNIT II **9 Hours**

JUICE EXTRACTION

Crushing - Crushers - Types, Crushing efficiency - Extraction of juice - methods, Accumulators - types - Maceration - Theory of cane diffusivity - different diffuser - ring diffuser - weighing of juice.

UNIT III **9 Hours**

CANE JUICE CLARIFICATION

Clarification - methods - clarifying agent - bleaching agent - Role of pH, non-sugars, colloids and gums in cane juice clarification. Liming of cane juice - CO2 P2O5 and its importance.

UNIT IV **9 Hours**

FILTRATION AND EVAPORATION PROCESS IN CANE INDUSTRY

Filtration of mud - Filter types - filter press, rotary vacuum filter - Rapi - Floc process. Filter cake washing. Evaporation - Evaporation rate - types of evaporators used in cane sugar industry - Cleaning of evaporators - Entrainment separator - methods - Boiling in Vacuum pan - Footing magma - Massecuite . A,B,C - Mother liquor, Molasses A,B,C Molasses exhaustibility.

UNIT V **9 Hours**

SUGAR PRODUCTION

Crystallization - Super saturation - Crystallizers type - batch and continuous. Centrifuge - types. Drying of sugar - conveyors for sugar - by-product from sugar mills - utilization.sugar production from beet, palm and coconut.

FOR FURTHER READING

Physical & chemical properties of sugars, Manufacture of sugar-free, sugarless carbonated beverages, Sugars and sweetening agents, Sugar alcohols.

Total: 45 Hours

Reference(s)

1. Ram Behari Lal and Mathur. 1972. Hand book of cane sugar technology. Oxford and IBH publishing company New Delhi
2. Introduction to cane Sugar technology, Jenkins G.H
3. Unit operation in cane sugar production-John H. Payne
4. Baikow, V.E. 1967. Manufacturing and refining of raw cane sugar. Elsevier Publishing Company, New York
5. McCabe, W.L. and J.e. Smith 1976. Unit operations in chemical engineering. McGraw Hill Kogakusha Ltd., Tokyo.

16FD012 FUNCTIONAL FOODS AND NUTRACEUTICALS

3 0 0 3

Course Objectives

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction
- To apply the methods to identify the activity of antioxidants and assessing suitable food for formulation
- To understand the role of Nutraceuticals and functional food in health and disease

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Understand the basics of nutraceuticals and phytochemicals
2. Analyse the soluble component of food products using qualitative and quantitative methods
3. Evaluate the methods used for assess the activity of antioxidants
4. Apply and analyse the role of Nutraceuticals and Functional foods in health aspects
5. Apply the suitable food safety regulations in food industry sector for getting healthy food

Articulation Matrix

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

UNIT I **5 Hours**

INTRODUCTION AND SIGNIFICANCE

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 **12 Hours**

ANALYSIS OF PHYTOCHEMICALS

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 **12 Hours**

ASSESSMENT OF ANTIOXIDANT ACTIVITY

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 110 natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV **12 Hours**

ROLE IN HEALTH AND DISEASE

Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V **4 Hours**

SAFETY ISSUES

Health Claims, regulations and safety issues- International and national.

FOR FURTHER READING

From Traditional Knowledge to an Innovative Approach for Bio-preservation in Food by Using Lactic Acid Bacteria - Some Bioactive Components in Food and Health Benefits -International Regulations for Labeling and Health Related Claims. Challenges in the Functional Food and Nutraceutical Market.

Total: 45 Hours

Reference(s)

1. Bisset, Normal Grainger and Max Wich H "Herbal Drugs and Phytopharmaceuticals" 2 nd Edition, CRC, 2001.
2. Wildman, Robert "Handbook of Nutraceuticals and Functional Foods". CRC, 2006.
3. Webb, P P. "Dietary Supplements and Functional Foods". Blackwell, 2006.
4. Ikan, Raphael "Natural Products: A Laboratory Guide", 2nd Edition, Academic Press / Elsevier, 2005.
5. Shi, John, Fereidoon Shahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor & Francis, 2007 .
6. Watson, Robald Ross "Functional Foods and Nutraceuticals in Cancer Prevention". Blackwell Publishing, 2007.

16FD013 READY TO EAT FOODS 3 0 0 3

Course Objectives

- Know the current status of snack food Industry
- Impart knowledge on various unit operations and manufacturing process in Different Snack Food Industries like Potato Processing, Tortilla Processing and Popcorn processing
- Study the difference between small scale level and industrial level processing of snack foods

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Outline of knowledge about current production and marketing status of Snack foods
2. Show the manufacturing steps involved in the production of potato chips and value added products from potato
3. Construct the flowchart for the processing steps and equipment's involved in the Tortilla chips processing
4. Carryout the selection and preparation of popcorn by industrial manufacturing process
5. Analyse the methods of sensory evaluation and packaging technologies in Snack Food Industries

Articulation Matrix

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

UNIT I **9 Hours**

SNACK FOOD INDUSTRY

Introduction-History-Past innovations- Outline of snack food industry- Nutrition-Total Quality Management of Technology-Domestic Snack Food Market-Global Market-Snack Food Association-Future Considerations

UNIT II **9 Hours**

POTATO CHIPS PROCESSING

Potato Production- Market value of Potato- History of Fabricated potato snacks- Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Future of Fabricated Potato snacks- Other value added products from Potato

UNIT III **9 Hours**

TORTILLA CHIP PROCESSING

Introduction- Raw Materials- Processing steps-Corn cooking and soaking-Washing and Draining-Grinding Equipment-Reconstitution of Dry Masa Flour- Masa feeding- Pumping- Preheating-Sheeting/Cutting- Baking- Conditioning/Equilibration-Frying

UNIT IV **9 Hours**

POPCORN PROCESSING

Introduction- Raw popcorn selection and preparation-Popping Methods-Home preparation of Popcorn-Equipments-Industrial manufacturing process- Flavorings and Applicators-Popcorn Packaging- Relative Nutrition- Marketing

UNIT V **9 Hours**

SENSORY EVALUATION AND PACKAGING SENSORY EVALUATION AND PACKAGING

Introduction- Analytical methods-Sensory methods- Sensory Aspect of Processing- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning-Case Packing- Current Issues in Snack Foods Packaging

FOR FURTHER READING

Ready to eat expanded products - breakfast cereals, Value added products from different pulses and millets, Baby foods - traditional batch processing, extrusion system for baby foods, papad process.

Total: 45 Hours

Reference(s)

1. Lusas, E. W., & Rooney, L. W. (Eds.) Snack foods processing. CRC Press, 2001
2. Panda, H, The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd. 2008

16FD014 DESIGN AND FORMULATION OF FOODS 3 0 0 3

Course Objectives

- To understand and evaluate the nutritional value of foods to formulate the balanced diet.
- To develop skills to assess and apply nutrition standards and guidelines for achieving optimum human nutrition and health
- To create the knowledge to design functional and special foods for the nutritional and health benefit

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. To understand the concept and analyse the nutritive value and health benefit of foods.
2. To apply the principles of menu planning process and to formulate the menus for different age groups
3. To analyse the nutritional requirements for balanced diet from infancy to adolescence and able to formulate therapeutic diets for diseases like diabetic and cardio vascular problems.
4. To evaluate the energy content and energy requirements using different standards and regulations.
5. To create the functional and special foods for the health benefit To create the functional and special foods for the health benefit 5. To create the functional and special foods for the health benefit

Articulation Matrix

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

UNIT I **9 Hours**

NUTRITION AND BALANCED DIET

Nutritive value and anti- nutritional factors present in cereals, pulses, oil seeds , fruits, vegetables, fish, meat and eggs- effect of processing on nutritive value of foods- Principles of Nutrition and Health-Food Preparation and Service: Principles and Methods

UNIT II **9 Hours**

MENU PLANNING

Explanation of terms- Principles of planning menus- Steps involved in planning menus- Food guide pyramid- Infant Foods: Formulation of weaning foods, Protein energy malnutrition- Formulating diet for preschool going (2-5 years) children-Food Selection and Meal Planning for different age groups

UNIT III **9 Hours**

BALANCED DIET

Diets during normal life cycle- Nutrition from infancy to adolescence- Nutritional requirements of different age groups- Geriatric nutrition- Nutrition for athletes- Therapeutic Diet: Diet therapy and types of therapeutic diet- Diet for diabetic mellitus- Diet for cardio vascular disease- Diet for gastro intestinal disease

UNIT IV **9 Hours**

ENERGY REQUIREMENT

Definition- units of energy- Energy content of foods- Physiological fuel value- Measurement of energy expenditure- BMR- Thermic effect of food- SDA- Methods of measurement- Factorial methods of estimating energy requirement of individuals- Regulation of energy metabolism

UNIT V **9 Hours**

FUNCTIONAL AND SPECIAL FOODS

Concepts for functional foods design, prebiotics & probiotics- nutraceuticals- designer foods- Space foods-Army foods-Athlete foods-Packaged food supply in Flights

FURTHER READING

Organic vs Inorganic Nutrients: Differences & Importance; Nature, type and scope of nutraceutical and functional foods; Techniques of assessment of nutritional status; Methods of measuring body composition: direct and indirect; Techniques to measure energy expenditure and energy intake. Techniques to assess physical fitness.

Total: 45 Hours

Reference(s)

1. Antia, F. P. Gopalan, C., Sastri, B. R., & Balasubramanian, S. C. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research. 1976
2. Antia, F. P. Clinical dietetics and nutrition with special reference to tropical foods. Clinical dietetics and nutrition with special reference to tropical foods.1966
3. Srilakshmi, B. Dietetics. New Age International. 2007

16FD015 FOOD BIOTECHNOLOGY 3 0 0 3

Course Objectives

- To provide knowledge of methods and tools applied to the production of biotechnologically derived foods and food ingredients
- To check safety assessment strategies for food developed through genetic engineering and to impart knowledge pertaining to development of foods that promote health and well-being

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Apply the principles of biotechnology in Food processing industries to improve the quality of foods
2. Execute the production of commercially important metabolites
3. Apply the principle of downstream processing and explain various stages involved in downstream processing
4. Evaluate the diagnostic techniques for food borne pathogens and toxins
5. Assess the safety aspects and social issues related to applications and implications of genetically modified foods

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO BIOTECHNOLOGY

Introduction -Biotechnology relating to the food industry - application of genetics to food production - Genetic Engineering Techniques- Recombinant DNA Techniques and Cloning Strategies - role of bio process engineering in biotechnology industry. Regulatory and Social aspects of biotechnology of foods. Biotechnological approaches to improve nutritional qualities and shelf life of fruits and vegetables live stock, poultry and fish products

UNIT II **9 Hours**

PRODUCTION OF PRIMARY AND SECONDARY METABOLITES

Production of commercially important metabolites - citric acid, lactic acid, acidic acid, gluconic acid, amino acids, Flavoring agents, colouring agents and vitamins. New protein foods - SCP; mushroom; algal proteins. Natural bio-preservatives - Nisin, Lacticin

UNIT III **9 Hours**

DOWNSTREAM PROCESSING

Principle of downstream processing -stages in downstream processing- solid liquid separation flotation-flocculation-filtration-types-centrifugation-cell disruption-concentration-evaporation liquid - liquid extraction-membrane filtration precipitation-adsorption-purification by chromatography

UNIT IV **9 Hours**

MOLECULAR DIAGNOSTIC TOOLS

Rapid detection techniques for food borne pathogens and their toxins; In-vitro evaluation of bacterial toxins by immunological techniques like slide agglutination, tube agglutination, gel diffusion assay; Genetic based diagnostic systems - Polymerase Chain Reaction (PCR). Micro array diagnostic methods to detect pathogens, pesticides, and toxins in the raw materials and food

UNIT V **9 Hours**

GM FOODS - SOCIAL AND ETHICAL ISSUES

Potential Impact of Biotechnology on Food Industries. GM foods and food security- Safety aspects and social acceptance - Ethical issues. GMOs- current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects

FOR FURTHER READING

Role of biotechnology in enzymology and product development, fermentation process, fruit juice extraction, genetic improvement of food grade microorganisms, Nutritional significance of food products developed by biotechnological techniques, Nutrigenomics.

Total: 45 Hours

Reference(s)

1. Bielecki S., Ed., Polak J., J. and Bielecki, Tramper S., Food Biotechnology, Elsevier Science Publishing Company, New Delhi, 2000
2. Joshi, V.K. and Pandey, A., Biotechnology - Food Fermentation, Volume. I & II, Education Publishing, New Delhi, 1999.
3. Gutierre, Gustavo F., Food Science and Food Biotechnology, CRC Press, New York, 2003
4. Crueger, W. and Crueger A., Biotechnology: A Textbook of Industrial Microbiology, Science Tech. Madison, USA, 1984
5. Knorr, D., Food Biotechnology, Marcel Dekker, New York. 1982.
6. Rita Singh, Food Biotechnology, Global vision publication house, Delhi, 2004.

16FD016 FOOD ALLERGY AND TOXICOLOGY 3 0 0 3

Course Objectives

- To know the various kinds of food allergens and basis of allergic reactions
- To be familiar with various natural toxins in food
- To determine different toxicants found in foods

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Find the hazards and the toxicity associated with food and their implications for health
2. Analyse the chemistry of food allergens and disorders associated with food
3. Assess the risk and exposure of toxins in food sampling
4. Determine the toxicants in foods by the qualitative and quantitative analysis
5. Critique the formation of toxins during post harvest processing or else during storage

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humoral and cell media resources. Allergen and mechanism of allergic resources

UNIT II **9 Hours**

FOOD ALLERGY AND SENSITIVITY

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

UNIT III **9 Hours**

PRINCIPLES OF TOXICOLOGY

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 **9 Hours**

DETERMINATION OF TOXICANTS IN FOOD SAMPLING

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, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity

UNIT V **9 Hours**

TOXICANTS FORMED DURING FOOD PROCESSING

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

FOR FURTHER READING

Toxicants and allergens in foods derived from plants, animals, marine, algae and mushroom, Derived food toxicants- processing and packaging Different types of hazards, Toxicants generated during food processing.

Total: 45 Hours

Reference(s)

1. Helferich, William and Carl K.Winter, Food Toxicology, CRC Press, 2001
2. Alluwalia and Vikas, Food Hygiene and Toxicology, Paragon International Publishers, 2007.
3. Shibamoto, Taka yuki and Leonard F.Bjeldanzes, Introduction to Food Toxicology, 2nd Edition, Academic Press, 2009.
4. Maleki, Soheila J. A.Wesley Burks, and Ricki M.Helm, Food Allergy, ASM Press, 2006.
5. Cliver, Dean O. and Hans P.Riemann, Food Borne Diseases, 2nd Edition, Academic Press/Elsevier, 2002.
6. Riemann, Hans P. and Dean O. Cliver, Food Borne Infections and Intoxications, 3rd Edition, Academic Press/Elsevier, 2006.

16FD017 MUSHROOM PROCESSING TECHNOLOGY

3 0 0 3

Course Objectives

- To understand the basic concepts and techniques of mushroom cultivation
- To plan the construction of houses for mushroom cultivation
- To apply suitable post-harvest processing technology and represent the advances in mycology

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Exemplify the Classification, Morphology and Nutrient profile of Mushrooms
2. Implement the mushroom cultivation techniques
3. Plan and execute the construction of mushroom houses
4. Carryout mushroom production and post-harvest management
5. Check the recent advances in mushroom cultivation

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

History and classification of Indian Mushrooms- Edible and Poisonous Mushroom- Mushroom Classification-Based on occurrence, Morphology- Edibility and poisonous properties, nuclear behaviour and ultra-structural changes during the development of the mushroom fungi. Morphological and Microscopical identification of mushrooms-Nutrient Profile of Mushroom- Protein, amino acids, calorific values, carbohydrates, fats, vitamins & minerals

UNIT II **9 Hours**

TECHNIQUES OF MUSHROOM CULTIVATION

Structure and construction of Mushroom House- Layout of traditional and green house method. Methods of Mushroom cultivation: Bed Method, Polythene Bag Method- Breeding conditions of mushroom strains: temperate conditions, Isolation of spawn, growth media- Principles of composting, machinery required for compost making, materials for compost preparation. Methods of Composting-Long method of composting (LMC) & Short method of composting (SMC)

UNIT III **9 Hours**

CONSTRCTION OF MUSHROOM HOUSES

Structure and construction of Mushroom House- Layout of traditional and green house method-Methods of Mushroom cultivation: Bed Method-Polythene Bag Method-Principles of composting, machinery required for compost making-Methods of Composting-Long method of composting (LMC) & Short method of composting (SMC)

UNIT IV **9 Hours**

PROCESSING TECHNOLOGY

Cultivation of Oyster-Paddy and Button mushroom-Preparation of Pure Culture and spawn cultivation methods and harvesting- Post harvest technology: Storage-Freezing- dry Freezing- drying- canning-quality assurance and entrepreneurship

UNIT V **9 Hours**

ADVANCED MYCOLOGY

Genetic development process in Mushroom cultivation- Genetically edited mushrooms- Selection, Anastomosis, Hybridization, Mutagenesis, Protoplast fusion- G0enetic engineering- Genetically modified mushrooms: White mushrooms, Advantages and disadvantages-Medicinal and nutritional value- Health benefits- Microbicidal effects

FOR FURTHER READING

Diseases and problems of mushroom cultivation, Value added products from mushroom, mushroom marketing, entrepreneurship development in mushroom cultivation.

Total: 45 Hours

Reference(s)

1. Mushroom Production and Processing Technology, PathakYadav Gour Published by Agrobios India, 2010.
2. Mushroom Cultivation, Tripathi, D.POxford & IBH Publishing Co. PVT.LTD, New Delhi,(2005)
3. Gupta,P. K. Elements of Biotechnology.2nd Edition (3rd Reprint) 2015.
4. Kannaiyan, S. Ramasamy, K. A hand book of edible mushroom, Today & Tomorrows Printers &Publishers, New Delhi 1980
5. Pathak, V. N. and Yadav, N., Mushroom Production and Processing Technology, Agrobios, Jodhpur, 1998.

16FD018 PLANTATION AND SPICE PROCESSING 3 0 0 3

Course Objectives

- Understand Coffee and Tea Processing Techniques and its quality grading
- Analyze the methods of processing for Cashew, Coconut, Vanilla and Cocoa
- Evaluate the Processing and Extraction Techniques of Major and Minor spices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Assess the unit operations and processing steps involved in the manufacture of tea and coffee
2. Apply the processing techniques of cashew and coconut to develop value added products
3. Analyze the chemistry and manufacturing techniques of Vanilla and cocoa products
4. Compare the processing methods and extraction techniques of major spices
5. Evaluate the extraction of flavour components from minor spices

Articulation Matrix

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

UNIT I **9 Hours**

COFFEE AND TEA PROCESSING

Coffee- Occurrence - chemical constituents - harvesting - fermentation of coffee beans fermentation- drying- roasting- Process flow sheet for the manufacture of coffee powder- Instant coffee, technology- Chicory chemistry- Quality grading of coffee- Tea - occurrence- chemical constituents- harvesting - types of tea- green, oolong and CTC - Chemistry and technology of CTC tea - Manufacturing process - Green tea manufacture- Instant tea manufacture - Grading of tea.

UNIT II **9 Hours**

CASHEW AND COCONUT PROCESSING

Cashew-Importance - harvesting- products - uses of cashew & CSNL- cashew nut processing - methods of roasting - shelling - grading- packaging- infestation- Hygiene and safety. Coconut- harvesting - Processing technology of Virgin Coconut oil- Desiccated Coconut, Milk Cream, Nata-de-Coco, Packed Tender Coconut Water- Vinegar and Activated Carbon.

UNIT III **9 Hours**

VANILLA AND COCOA PROCESSING

Vanilla- Occurrence -chemistry of vanilla -stage of harvesting - different curing techniques -quality control and grading of cured beans -vanillin extraction methods - super critical fluid extraction of vanillin- Cocoa - Occurrence - Chemistry of the cocoa bean - changes taking place during fermentation of cocoa bean - Processing of cocoa bean - cocoa powder - cocoa liquor manufacture- Chocolate - Types - Chemistry and technology of chocolate manufacture - Quality control of chocolates.

UNIT IV **9 Hours**

MAJOR SPICE PROCESSING

Importance for spices - production and export status - stages and methods of harvest of important spices- equipment used for threshing, shelling, decortications of spices-Processing of cardamom-stage of harvest-processing of pepper-harvesting- packaging-processing of white pepper - wet and dry pulping and retting methods - drying; Processing of turmeric - Processing of chilli - harvesting and drying - packaging and grinding - low temperature grinding - advantages - refrigerant used - construction and working

UNIT V **9 Hours**

MINOR SPICE PROCESSING

Minor Spices - processing of Cumin, Coriander, Cinnamon, fenugreek, Garlic and Clove- Oleoresins and essential oils- Method of manufacture - Chemistry of the volatiles- Enzymatic synthesis of flavor identicals - Quality control - Processing of ginger -harvesting, washing, drying, and packaging - quality aspects - processing of clove, nutmeg and other minor spices- Packaging and storage of spices - quality analysis- AGMARK and ASTA standards.

FURTHER READING

Value addition of spices, turmeric, areca nut, oil palm processing, chemistry of different spice flavours, adulteration in spices.

Total: 45 Hours

Reference(s)

1. Chakraverty, A, Arun S. Mujumdar, G.S.Vijayaraghavan, and Hosahalli. S. Ramaswamy.Handbook of Post Harvet Technology: Cereals, Fruits, Vegetables, Tea and Spices, Marcel Dekker. Inc. New York.2003
2. Board, N. I. I. R.Hand Book on herbs cultivation & processing. Asia Pacific Business Press, 2004
3. Kader, A. A. Postharvest Technology of Horticultural Crops, Second Edition, Division of Agriculture and National Resources, California University. 1992
4. Minifie Bernard W, Chocolate, Cocoa and Confectionery Technology, Third Edition, Aspen Publication, 1999.

16FD019 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT

3 0 0 3

Course Objectives

- To introduce process economics and industrial management principles to Food engineers
- To teach principles of cost estimation, feasibility analysis, management, organization and quality control
- To introduce some of the fundamental tools and concepts of economic balance and quality control

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Demonstrate the organizational structure and concepts of management
2. Analyze the cost economics
3. Justify the investment, profit and alternate policies
4. Evaluate the annual report and performance analysis
5. Implement the economic and operations management quality control

Articulation Matrix

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

UNIT I **15 Hours**

PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION

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- principlesof time study- elements of production control- forecasting- planning- routing; - cheduling- dispatching- costs and costs control, inventory and inventory control

UNIT II **10 Hours**

ENGINEERING ECONOMICS FOR PROCESS ENGINEERS

Time Value of money- capital costs and depreciation- estimation of capital cost- manufacturing costs and working capital- invested capital and profitability

UNIT III **8 Hours**

PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT

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

UNIT IV **4 Hours**

ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE

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

UNIT V **8 Hours**

ECONOMIC BALANCE AND QUALITY CONTROL

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

FOR FURTHER READING

Business management, production analysis and pricing, estimation, costing, accounting and investment decision.

Total: 45 Hours

Reference(s)

1. Peters, M. S. and Timmerhaus, C. D. Plant Design and Economics for Chemical Engineers 5th Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K. Introduction to process Economics, 2nd Edn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V. Production and Costing, Khanna Publishers,New Delhi, 1988.
4. Allen, L.A.,Management and Organization, McGraw Hill.
5. Perry, R. H. and Green, D.,Chemical Engineer’s Handbook, 7th Edn., McGraw Hill.

16FD020 ENTREPRENEURSHIP DEVELOPMENT FOR FOOD TECHNOLOGISTS

3 0 0 3

Course Objectives

- To Develop the Entrepreneurial skills for Food Technologists
- To Acquire basic knowledge in Trade license and registration marks, Sources of finance, Selection of land and factory sheds
- To Impart knowledge on Preparation of project report, Market feasibility reports , Techno-economic feasibility report

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Describe the meaning and role of an entrepreneur and the functions
2. Check the policies and regulations for entrepreneurship
3. Generate the business plan and evaluate the feasibility
4. Generate and launch small business plan
5. Apply the guidelines of developed business plan to manage small business

Articulation Matrix

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

UNIT I **9 Hours**

ENTREPRENEURAL COMPETENCE

Entrepreneurship concept- Entrepreneurship as a Career- Entrepreneur Personality Characteristics- Knowledge- Skills- Attitude Requirement

UNIT II **9 Hours**

ENTREPRENEURAL ENVIRONMENT

Business Environment- Role of Family and Society- Entrepreneurship Development Training and Other Support Organizational Services- Central and State Government Industrial Policies and Regulations- International Business

UNIT III **9 Hours**

BUSINESS PLAN PREPARATION

Sources of Product for Business- Prefeasibility Study- Criteria for Selection of Product- Ownership- Capital- Budgeting Project Profile Preparation- Matching Entrepreneur with the Project- Feasibility Report Preparation and Evaluation Criteria

UNIT IV **9 Hours**

LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization Operations Planning- Market and Channel Selection- Growth Strategies- Product Launching

UNIT V **9 Hours**

MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business- Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business

FOR FURTHER READING

Entrepreneurial development, food business management, SWOT Analysis, preparation of project report, market assessment.

Total: 45 Hours

Reference(s)

1. Hisrich, "Entrepreneurship", Tata McGraw Hill, New Delhi, 2005.
2. Saravanavel, P.,'Entrepreneurial Development', Ess Pee kayPublishing House, Chennai, 2005
3. Khanka, S S.,"Entrepreneurial Development", S.Chand and Co Limited, New Delhi, 2001.
4. Jain, P C.,"Handbook for New Entrepreneurs", Second Edition, Oxford University Press, New Delhi, 2002.

16FD021 ENTERPRISE RESOURCE PLANNING (ERP) 3 0 0 3

Course Objectives

- Understand the fundamental concepts of ERP systems, their architecture, and working of different modules in ERP.
- Develop and design the modules used in ERP systems, and can customize the existing modules of ERP systems
- Create an awareness with regard to application of ERP in Enterprises and Open Source ERP

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Demonstrate the basic issues in Enterprise Systems
2. Conclude with a suitable solution for small, medium and large enterprise vendors
3. Assess an organization's readiness for enterprise system implementation with a professional approach
4. Implement ERP and assess its success and failure factors
5. Apply the concepts of BPR, SCM and CRM based on its emerging requirements

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Overview of enterprise systems - Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems

UNIT II **9 Hours**

ERP SOLUTIONS AND FUNCTIONAL MODULES

Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR,and best business practices - Business process Management, Functional modules

UNIT III **9 Hours**

ERP IMPLEMENTATION

Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training - Data Migration. People Organization in implementation- Consultants, Vendors and Employees

UNIT IV **9 Hours**

POST IMPLEMENTATION

Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation

UNIT V **9 Hours**

EMERGING TRENDS ON ERP

Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing

FOR FURTHER READING

Implementation and maintaining ERP in milk industry, Software used for ERP (SAP etc.), Practical difficulties in implementing ERP.

Total: 45 Hours

Reference(s)

1. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System,Wiley India, 2012
2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
3. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
4. MahadeoJaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
5. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.

16FD022 SUPPLY CHAIN AND RETAIL MANAGEMENT

3 0 0 3

Course Objectives

- Familiarize the basics of business, management, the legal environment, and issues relating to governance and ethics
- Enrich knowledge on key areas related to management of retail services
- Acquire skills necessary to successfully carve a career in retail management

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyze and understand the manufacturing and partnership strategies in food sector
2. Assess the opportunities and challenges in marketing of food products
3. Demonstrate the food safety standards involved in retail sector
4. Demonstrate the various operations involved in supply chain

5. Apply logistics and purchasing in globalization

Articulation Matrix

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

UNIT I **9 Hours**

FOOD MARKETING

Food Marketing System- Process, Growth, Role and Economic importance - Basic marketing concepts and approaches - marketing functions - Market Structure, Conduct and Performance - organizational issues. Concept, Forms of food supply chain, Factors affecting the chain - Supply Chain Partnerships - Contracts, Strategic Alliances

UNIT II **12 Hours**

MARKETING RESEARCH

Food Consumption and Marketing- Preferences, Demography, consumption and expenditure patterns. Analyzing agricultural and food sectors: Agricultural commodity sectors, Food Processing and Manufacturing - Location, structure and problems, Innovation. Wholesaling and Retailing in food - International Food Market & Agribusiness Marketing: Trends, International Competitiveness, Barrier to trade, Porter's framework, Risk management and futures market, Marketing and Market Research: Consumer behavior and market research, Survey analysis and multivariate techniques in market research

UNIT III **6 Hours**

RETAIL MANAGEMENT

Sourcing and procurement, Purchase management - Innovations in Food Chains, Quality Management, Private Food Quality and Safety Standards, Food safety and the supply chain

UNIT IV **12 Hours**

SUPPLY CHAIN MANAGEMENT

Integrated Materials Management - Alternative Inventory models - Transportation - Network design - Supply Chains for Perishables. Warehouse Management - procedures, storage structures, cost of storage, insurance and issues. Information Technology and Supply Chain, Traceability, Identity, Preservation issues in the Food System - Retail supply chain management, Changes in Retail, Food Delivery

UNIT V **6 Hours**

GLOBALIZATION

Supply chain strategy at the firm - Efficient Consumer Response - Measurement of consumer response - Experimental Economics Approach - Globalization and logistics: Addressing global competitiveness

FOR FURTHER READING

Ways to improve supply chain management by retailers, how to lower Retail Supply Chain Costs, working of RFID in supply chain management, Impact of FDA on retail sales.

Total: 45 Hours

Reference(s)

1. Sunil Chopra, Peter Meindl . Supply Chain Management: Strategy, Planning, and Operation, Prentice Hall, 2nd ed. 2004
2. Kohls, R.L., and J.N. Uhl. Marketing of Agricultural Products, 8th ed. New York:Macmillan 1998.
3. Kotabe, M, and K. Helsen, Global Marketing. 2nd ed. New York: Wiley, 2001
4. Rhodes, V.J., and J.L, Dauve.. The Agricultural Marketing System. 5th ed. Scottsdale, Ariz. Hathaway, 1998
5. Kenneth Lysons, Brian Farrington Purchasing and Supply Chain Management, Prentice Hall, 2005.

16FD023 TOTAL QUALITY MANAGEMENT (TQM) 3 0 0 3

Course Objectives

- To make the students understand the basic concepts of total quality management and appreciate its importance in today's business environment
- To enable them to acquire required diagnostic skills and use various quality tools
- To familiarize the students about the Quality Management System

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Apply TQM concepts for improving the quality of products and services
2. Implement the basic principles of TQM in manufacturing and service based organization
3. Apply the tools and techniques of quality management to manufacturing and service processes
4. Predict the improvement necessary for the better performance
5. Implement Quality Management System.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction - Definition of quality - Quality control tools - Quality control chart - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Quality Gurus - Barriers to TQM - Cost of Quality

UNIT II **9 Hours**

TQM PRINCIPLES

Quality statements - Customer focus -Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Continuous process improvement - PDCA cycle, 5s, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating

UNIT III **9 Hours**

TQM TOOLS

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 **9 Hours**

TQM TOOLS

Quality circles - Quality Function Deployment (QFD) -Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures - BPR

UNIT V **9 Hours**

QUALITY SYSTEMS

Need for ISO 9000- ISO 9000-2000 Quality System - Elements, Documentation, Quality auditing- QS 9000 -ISO 14000- ISO 22000 - Concepts, Requirements and Benefits -Quality Council - Leadership, Employee involvement -Motivation, Empowerment, Team and Teamwork, Recognition and Reward

FOR FURTHER READING

Application of TQM in food industry-A case study (Beverage industry, Dairy industry etc.), TQM in food industry- Benefits, Current situation and potential in India.

Total: 45 Hours

Reference(s)

1. Evans, James R. and William M. Lindsay, "The Management and Control of Quality".6th Edition South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM - Text with Cases", 3rd Edition. Butterworth - Heinemann, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", PHI, 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management - Text and Cases". PHI, 2006.
5. Besterfiled, Dale H. et al., "Total Quality Management", 4th Edition, Pearson Education. Asia, 2006.

16FD024 SENSORY EVALUATION OF FOODS 3 0 0 3

Course Objectives

- To understand the influence of taste, odour and colour perception on sensory quality
- To apply the principles of sensory evaluation methodologies.
- To evaluate the sensory quality of foods using instruments

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. To assess the perception of senses by human sensory organs
2. To apply the sensory principles and practices to establish sensory panel and facilities
3. To choose the appropriate sensory evaluation tests related to the quality of foods
4. To analyze the sensory quality of foods using instruments
5. To evaluate the sensory evaluation by applying basic statistical concepts.

Articulation Matrix

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

UNIT I **9 Hours**

HUMAN SENSES - ANATOMY, PHYSIOLOGY AND PERCEPTION

Aim of sensory evaluation and Applications. Sensory properties and human senses. Importance of Taste, odour, Colour and Texture. Structure and physiology of taste organs - tongue, papillae, taste buds, salivary glands. Mechanism of taste perception- Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami. olfactory organs and receptors - physiology of odour perception and colour perception Texture classification and texture perception.

UNIT II **9 Hours**

SENSORY PANELS AND TESTING FACILITIES

Establishing sensory panels - Types of panels (Trained panel, discriminative and communicative panel). Selection, training and performance monitoring. Factors influencing sensory verdicts.

Response Errors - Types and Steps to reduce the errors. Designing Sensory Testing Facilities. Sampling, preparation and presentation of samples. Panel Measurement scales.

UNIT III **9 Hours**

METHODS OF SENSORY EVALUATION

Methodology for sensory evaluation: Consumer oriented tests and Product Oriented tests. Consumer oriented tests- Preference test, Acceptance test, Hedonic test. Product Oriented tests - Threshold tests; Discriminative test - paired comparison, Duo-trio, triangle; Ranking, Sensitivity Test, Descriptive test - flavor profiling, texture profiling, ratio scaling, quantitative descriptive analysis.

UNIT IV **9 Hours**

INSTRUMENTATION IN SENSORY EVALUATION

Need for Instrumentation in sensory evaluation. Colour Measurement - spectrophotometry, colorimetry, Munsell colour system, CIE colour system, Hunter colour system, Electronic eye (IRIS). Texture measurement - Basic rheological instruments, Texture analyzer. Taste measurement- E-tongue. Odour measurement- E nose, GC - olfactory.

UNIT V **9 Hours**

STATISTICAL ANALYSIS OF SENSORY EVALUATION

Conducting a sensory study. Basic statistical concepts for sensory evaluation: Hypothesis testing and sensory inference, variation of T Test, Nonparametric and binomial based Statistical methods, Chi-square test, analysis of variation, Correlation regression.

FURTHER READING

Recent trends in Sensory analysis of food products. Instrumentation advancements in sensory science.

Total: 45 Hours

Reference(s)

1. Lyon, D.H., Francombe, M.A., Hasdell, T.A., Lawson, K. (eds), Guidelines for Sensory Analysis in Food Product Development and Quality Control. Chapman and Hall, London, 1992.
2. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation. Academic Press, New York, 1965.
3. Martens, M.; Dalen, G.A.; Russwurm, H. (eds): Flavour Science and Technology. John Wiley and Sons, Chichester, 1987.
4. Moskowitz, H.R. (eds), Food Texture: Instrumental and Sensory Measurement. Marcel Dekker Inc. New York, 1987
5. Rao E. S.. Food Quality Evaluation, Variety Books. 2013.
6. B. M. Watts, G. L. Ylimaki, L. E. Jeffery, L. G. Elias, Basic Sensory Methods For Food Evaluation, 1989

16FD025 EMERGING TECHNOLOGIES IN FOOD PROCESSING

3 0 0 3

Course Objectives

- To understand and apply the different emerging technologies in processing of foods
- To familiarize about the equipment used for the processing of foods by novel technologies
- To compare the application of alternate thermal and non-thermal processing techniques on foods

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Understand the effect of high pressure processing on microbial inactivation of foods
2. Apply the principle of pulsed electric field and analyse the impact of pulsed electric field processing for both solid and liquid foods
3. Apply and assess the irradiation dosage requirement for foods
4. Apply non thermal technologies for inactivation of microorganisms and improve the food quality
5. Apply advanced thermal treatments for food processing and preservation

Articulation Matrix

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

UNIT I **9 Hours**

HIGH PRESSURE PROCESSING

Principles - Mechanism and applications of high pressure processing to food systems - High pressure processing of salads, meats and sea foods, fruits and fruit products -Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods - Other applications of high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

UNIT II **8 Hours**

PULSED ELECTRIC FIELDS PROCESSING

Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology - Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

UNIT III **8 Hours**

FOOD IRRADIATION

Introduction - Fundamentals of food Irradiation - Type and sources of radiation, dosimetry, mode of action of ionizing radiation - Direct and indirect effect, radiation effect on food constituents, Dose requirement for different products and regulations.

UNIT IV **12 Hours**

ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES

High intensity pulsed light technology:- principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ultrasound Processing:Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultra sound on properties of foods - Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms.

UNIT V **8 Hours**

ALTERNATIVE THERMAL PROCESSING TECHNIQUES

Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating - combined microwave-vacuum drying, microwave freeze-drying - applications.

FOR FURTHER READING

Ohmic heating, UV: Equipment- processing- effect of UV on microorganisms and enzyme- application of UV in food processing.Safety and standards regulations of novel processing on food.

Total: 45 Hours

Reference(s)

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1 Edition, 2005.
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. BarbosaCanovas, CRC Press, 1st Edition, 2004.
3. Maria Laura Passos, Claudio P. Ribeiro, Innovation in Food Engineering: New Techniques and Products, CRC press, 2010.
4. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V. M. Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan, Nonthermal Processing Technologies for Food,2000
5. Amit K. Jaiswal, Food Processing Technologies: Impact on Product Attributes. CRC Press, 2017

ENTREPRENEURSHIP ELECTIVES

15GE001 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc

Programme Outcomes (POs)

Course Outcomes (COs)

1. Able to gain Knowledge about entrepreneurship, motivation and business.
2. Able to develop small scale industries in different field.

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractionation, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

15GE002 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promoting the product / services
- Handle the human resources and taxation
- Understand Government industrial policies / support provided and prepare a business plan

Programme Outcomes (POs)

Course Outcomes (COs)

1. Increase in awareness of the entrepreneurship Development for engineering decisions.

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment,Segmentation, Targeting and positioning, Formulating marketing strategies,Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.htm

PHYSICAL SCIENCE ELECTIVES

15GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Understand the fundamentals of physics of nanomaterials
- Correlate on multidisciplinary branch
- Acquire the knowledge in nanomaterials synthesis, compile and analyze data and draw conclusions at nano level

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Classify the size dependant properties of different nanomaterials
2. Explain different experimental methods used for the preparation of nanomaterials
3. Analyse the data using different characterization techniques
4. Illustrate the different techniques to synthesize semiconductor nanostructures and utilize them for application
5. Identify the impact of nanomaterials and their applications in Nano devices

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures,nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -magnetic properties of nanoscale materials -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - chemical vapour deposition, plasma enhanced CVD, colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization - DC sputtering and RF sputtering process.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials.

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LEDÃƒÂ¢??s - basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- nano motors - bio nano particles-nano - objects - applications of nano materials in biological field.

FOR FURTHER READING

Application of graphene in various field - supercapacitors - third generation solar cell-dye sensitized solar cell (DSSC) -fuel cells.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, Handbook of Nanoscience, Engineering, and Technology, CRC Press, 2012.
2. Charles P. Poole Jr and. Frank J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2007.
3. Guozhong Cao, Y. Wang, Nanostructures and Nanomaterials-Synthesis, Properties & Applications, Imperials College Press, 2011.
4. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw - Hill Education (India) Ltd, 2012.
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, Fuel cells: Principles and Applications, University Press, 2009.

15GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES

3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Exemplify the drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the electric field and space charge width of PN junction under different biasing
3. Explain the charge flow, temperature effects, turn on and turn off transients in PN junction diode
4. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations.
5. Represent the working mechanism of opto-electronic devices

UNIT I **9 Hours**

CARRIER TRANSPORT IN SEMICONDUCTORS

Carrier drift - drift current density - mobility effects on carrier density - conductivity in semiconductor - carrier transport by diffusion - diffusion current density - total current density - breakdown phenomena - avalanche breakdown.

UNIT II **9 Hours**

PHYSICS OF P-N JUNCTION

Basic structure-Built in potential barrier, Electric field and space charge width of P-N junction under zero, forward and reverse bias- Diffusion capacitance - one sided and linearly graded junctions.

UNIT III **9 Hours**

P-N JUNCTION DIODE

Qualitative description of charge flow in p-n junction - boundary condition - minority carrier distribution - ideal p-n junction current - temperature effects - applications - the turn on transient and turn off transient.

UNIT IV **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

Introduction to basic principle of operation - the modes of operation - amplification - minority carrier distribution in forward active mode - non-ideal effects - base with modulation - high injection emitter band gap narrowing - current clouding - breakdown voltage - voltage in open emitter configuration and open base configuration.

UNIT V **9 Hours**

OPTO ELECTRONIC DEVICES

Optical absorption in a semiconductor, photon absorption coefficient - electron hole pair generation - solar cell - homo junction and hetero junction - Photo transistor - laser diode, the optical cavity, optical absorption, loss and gain - threshold current.

FOR FURTHER READING

Organic semiconductors- diodes - transistors-working and applications

Total: 45 Hours

Reference(s)

1. Donald A Neamen, Semiconductor Physics and Devices, Tata McGraw Hill, 2012.
2. S. M. Sze and M. K. Lee, Semiconductor Devices, Physics and Technology, John-Wiley & Sons, 2015.
3. Ben. G. Streetman and S. K. Banerjee , Solid State Electronic Devices, Pearson Education Ltd, 2015.
4. C. Kittel, Introduction to Solid State Physics, John-Wiley & Sons, 2012.
5. J. Millman and C. Halkias, Electronic Devices and Circuits, Tata McGraw Hill, 2010.
6. Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley-VCH, 2006.

15GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - Einstein's prediction - spontaneous emission - stimulated emission - Einstein's relations - A and B coefficients - population inversion - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification. Components of lasers: active medium - pumping - pumping mechanisms - resonant cavity.

UNIT II **9 Hours**

CHARACTERISTICS AND TYPES OF LASERS

Introduction - directionality - intensity - coherence - monochromaticity. Classification of lasers - principle, construction, working, energy level diagram and applications of CO_2 laser - dye laser - excimer laser - Nd:YAG laser - semiconductor laser.

UNIT III **9 Hours**

LASERS IN SCIENCE

Harmonic generation - stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - LIGO - rotation of the earth - measurement of distance - velocity measurement - holography.

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Eye laser surgery - LASIK - photocoagulations - light induced biological hazards: Eye and skin - homeostasis - dentistry - laser angioplasty - laser endoscopy - different laser therapies.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting. Laser tracking: LIDAR. Lasers in electronics industry: ranging - information storage - bar code scanner. Lasers in defence: laser based military weapons - laser walls.

FOR FURTHER READING

Q-switching - mode locking - thermo-optic effects - astronomy lasers - fighting crime with lasers - laser engraving.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015.
2. M. N. Avadhanulu, An Introduction to Lasers Theory and Applications, S. Chand Publisher, 2013.
3. W. Koechner, M. Bass, Solid State Lasers: a graduate text, Springer Verlag, New York, 2006.
4. K. P. R. Nair, Atoms, Molecules and Lasers, Narosa Publishing House, 2009.
5. K. R. Nambiar, Lasers: Principles Types and Applications, New Age International Publications, 2006.
6. A. Sennaroglu, Solid-State Lasers and Applications, CRC Press, 2006.

15GE0C1 CORROSION SCIENCE 3 0 0 3

Course Objectives

- Recognize the terminologies used in corrosion science.
- Impart knowledge about the various types of corrosion and its mechanism.
- Understand the various methods of corrosion control, corrosion testing and monitoring.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. evaluate if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. calculate the rate of corrosion on metals using electrochemical methods of testing
5. propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

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

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - passivation - direct and indirect damage by corrosion - importance of corrosion prevention in industries - area relationship in both active and passive states of metals - Pilling Bedworth ratio and its significance - units of corrosion rate (mdd and mpy) - importance of pitting factor - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages.

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion. High temperature oxidation, kinetics of protective film formation and catastrophic oxidation corrosion.

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - cracking - corrosion fatigue - filliform corrosion - fretting damage and microbes induced corrosion - corrosion mechanism on steel, iron, zinc and copper metal surfaces - thick layer and thin layer scale formation - in situ corrosion scale analysis.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: factors affecting corrosion - electrochemical methods of polarization - Tafel extrapolation polarization, linear polarization, impedance techniques - weight loss method - susceptibility test - testing for intergranular susceptibility and stress corrosion. Visual testing - liquid penetrant testing - magnetic particle testing - eddy current testing.

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection. Stray current corrosion problems and its prevention. Protective coatings: anodic and cathodic coatings - metal coatings: hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of sacrificial anode for corrosion control.

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems.

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, Introduction to Corrosion Engineering, CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.

3. R. Winstone Revie and Herbert H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill, Singapore, 2008.
5. David E.J. Talbot (Author), James D.R. Talbot, Corrosion Science and Technology, Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

15GE0C2 ENERGY STORING DEVICES AND FUEL CELLS

3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles.
- Identify the types of fuel cells and to relate the factors of energy and environment.
- Analyze various energy storage devices and fuel cells.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Analyze the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Identify different methods for the production of hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of practical batteries - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge.

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries- zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells.

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - biomass pyrolysis -gas clean up - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy - life cycle assessment of fuel cell systems. Solar Cells: energy conversion devices, photovoltaic and photoelectrochemical cells - photobiochemical conversion cell.

FOR FURTHER READING

Energy conservation, Over utilization, Energy demanding activities.

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009.
2. F. Barbir,PEM fuel cells: Theory and practice,Elsevier, Burlington, MA, Academic Press, 2013.
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001.
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012.
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016.
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

15GE0C3 POLYMER CHEMISTRY AND PROCESSING

3 0 0 3

Course Objectives

- Impart knowledge on the basic concepts of polymers and its mechanism
- Use the appropriate polymerization techniques to synthesize the polymers and its processing
- Select the suitable polymers for various applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

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

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical polymerization - cationic, anionic and co-ordination (Ziegler-Natta) polymerization, copolymerization, condensation polymerization (nylon-6,6) ring opening polymerization (nylon-6). Elastomers: Natural rubber - vulcanization - synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone(PEEK), polysulphones, polyimides.

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion

polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation.

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties by TGA and DSC, Testing tensile strength, Izod impact, Compressive strength, Rockwell hardness, Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption.

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plactics fabrication: hand-layup - filament winding and pultrusion.

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration.

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International (P) Ltd., New Delhi, 2015.
2. Joel R. Fried, Polymer Science and Technology, Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, Polymer Analysis, John Wiley & Sons, New York, 2008
5. George Odian , Principles of Polymerization, John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, Introduction to Polymers, CRC Press, New York, 2011

OPEN ELECTIVES

16FD0YA TRADITIONAL FOODS **3 0 0 3**

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

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

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction- 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 II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:-Rasgolla, Gulabjamun; formulation and preparation of namkeen, papads, vada, potato chips, banana chips, samosa etc. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing; milk based puddings/ desserts

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Tempe, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing procedures to reduce loses of nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods ÃƒÂ¢-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 **7 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

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.

FOR FURTHER READING

Specific social contexts, religious festivals, breakfast, meal and snack foods of different regions of India, typical fast foods / junk foods, Street foods.

Total: 44 Hours

Reference(s)

1. Sen and 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.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

16FD0YB FOOD LAWS AND REGULATIONS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

Articulation Matrix

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

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labeling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

FOR FURTHER READING

Food quality, Nutritional labeling, labeling regulations, Food composition analysis, Food adulteration and detection techniques, Hygienic practices, Novel food packaging, Food advertisement methods.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

16FD0YC POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- To understand the importance and different methods of post harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

Programme Outcomes (POs)

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Implement the different post harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

Articulation Matrix

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

UNIT I **6 Hours**

POST-HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **15 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Definition and need for value addition, Requirements of a food processing unit. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup. Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipments. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing- changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **6 Hours**

PRESERVATION BY CONCENTRATION AND FERMENTATION

Preservation by Concentration- Methods, changes during concentration. Preservation by fermentation - sauerkraut and pickles. Utilization of fruit and vegetable waste.

UNIT V **9 Hours**

PRESERVATION BY CANNING

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

FOR FURTHER READING

Toping of sugar/salt, Hybrid drier, safe level of irradiation, solid state fermentation, layout of fruit/vegetable canning unit

Total: 45 Hours

Reference(s)

1. S.Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

ADDITIONAL ONE CREDIT COURSES

15GE0XA HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Programme Outcomes (POs)

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness

UNIT I **5 Hours**

FITNESS

Meaning & Definition- Need & importance of Physical fitness ÃƒÂ¢?? Types Physical fitness - Exercise, Training and Conditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition Ãƒ??Ãƒ?Ã‚¢?? Principles of practicing Ãƒ??Ãƒ?Ã‚¢?? Basic Asana and it important Ãƒ??Ãƒ?Ã‚¢?? Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important ÃƒÂ¢?? Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause ÃƒÂ¢?? prevention ÃƒÂ¢?? First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

15GE0XB FOUNDATION COURSE IN COMMUNITY RADIO TECHNOLOGY

1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for radio broadcasting
- provide solutions for real world applications

Programme Outcomes (POs)

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording
2. Examine the available options for telephony interfaces for radio
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work

UNIT I **3 Hours**

INTRODUCTION TO COMMUNITY RADIO

Evolution of Community Radio (CR) in India- principles behind setting up of CR- policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio

UNIT III **3 Hours**

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production- telephony interfaces for radio- audio Post Production

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V **3 Hours**

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable- propagation and coverage of RF signals-FM transmitter setup

UNIT VI **2 Hours**

MODULARITY AND CODE REUSABILITY

FUNCTIONS

Defining a function - Calling a function - Pass by reference - Function arguments - return - statements - Scope of variables - Recursion - Import statement - from...import statement - from...import * statement

UNIT VII **4 Hours**

ADVANCED CONCEPTS

File Handling Operations
Opening and closing files - Reading and writing files - Renaming and deleting files - Directories in Python

Handling Runtime Errors - Exception Handling
Exceptions - Handling exceptions - Raising exceptions - user-defined exceptions

Object Oriented Programming in Python - Classes and Objects - Methods - Principles of Object Orientation - Inheritance - Polymorphism - Encapsulation

Total: 21 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook
2. Vinod Pavarala, Kanchan K Malik, Ã*ƒ*Â¢??Other Voices: The Struggle for Community Radio in IndiaÃ*ƒ*Â¢??, SAGE Publications India,2007
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, SeÃ*ƒ*Â¡n Ã*ƒ*? SiochrÃ*ƒ*Âº, Ã¢??Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and RegulationÃ¢??, University of Michigan Press, 2008
4. www.floridasound.com
5. www.mediacollege.com
6. www.procosound.com

15GE0XC VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

15GE0XD INTRODUCTION TO ALGORITHMS 1 0 0 1

Course Objectives

- Analyze the asymptotic performance of algorithms, Divide and conquer and Dynamic Problems
- Use Sorting and Searching algorithms for arranging the data
- Apply important algorithmic techniques to solve the real world Problem

Programme Outcomes (POs)
Course Outcomes (COs)

1. Apply Divide and conquer and Dynamic Programming Algorithm techniques to Provide the solutions for simple Problems
2. Design algorithms for Performing Sorting and Searching of data
3. Construct the Graph, Heap and BST for the given Data information

UNIT I **15 Hours**

INTRODUCTION TO ALGORITHMS

Algorithm Design Techniques: Divide and Conquer, Dynamic Programming, Sorting and Searching, Basic graph algorithms Ã¢??Simple Data Structures: Heaps, Balanced Search Trees

Total: 15 Hours

Reference(s)

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015
2. Thomas H. Cormen. Charles E. Leiserson. Ronald L. Rivest. Clifford Stein, Introduction to Algorithms, Second Edition, MIT Press, 2014
3. J.P.Tremblay and P.G.Sorenson, An Introduction to Data Structures with Application II Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008

15GE0XE ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication

Programme Outcomes (POs)
Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events

UNIT I **7 Hours**

CONVENTIONS

Acronyms Ã¢?? Abbreviations Ã¢?? Initialisms Ã¢?? Jargon Ã¢?? Neologisms - Idiomatic Expressions Ã¢?? Euphemisms Ã¢?? Spoonerisms Ã¢?? Malapropisms Ã¢?? Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Ã¢?? Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis Ã¢?? Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy,Goyal Publisher. Edition 2.2014.
2. C T Onions. The Oxford Dictionary of English Etymology.Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont.Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library.1961

15GE0XF HINDUSTANI MUSIC 1 0 0 1

Course Objectives

- To have an awareness on aesthetic and therapeutic aspects of Hindustani music
- To identify and differentiate the various styles and nuances of Hindustani music
- To apply the knowledge accumulated throughout the duration of the course by way of improvisation, composition and presentation

Programme Outcomes (POs)

Course Outcomes (COs)

1. Have Basic knowledge of aesthetic and therapeutic value of Hindustani Music

UNIT I **10 Hours**

AESTHETICS

Introduction to music - Aesthetics of Hindustani Music - Classification (Raga, instruments, style as per the presentation and the gharaanaas) - Folk music, Dhamaar, Dhrupad

UNIT II **10 Hours**

COMPOSITION AND THERAPEUTIC VALUE

Taal and Raga - Bandeesh, Taraanaa Ã¢?? Madhya and drut laya, Vilambit khyaal as demonstration - Therapeutic benefits of Hindustani music - Stage performance

Total: 20 Hours

Reference(s)

1. Devdhar B.R., Raga bodh (Part 1 & 2), Devdhar School of Indian Music, Mumbai, 2012.
2. Vasant, Sangeet Vishaarad , Hathras, Uttar Pradesh, 2015
3. raag-hindustani.com/
4. play.raaga.com/Hindustani

5. raag-hindustani.com/Scales3.html
6. www.poshmaal.com/ragas.html

15GE0XG CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING 1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

UNIT I **15 Hours**

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture Ã¢?? scope and importance of vermiculture Ã¢?? limiting factors - types of worm culturing and the relative benefits Ã¢?? Small scale and commercial methods: process & advantages Ã¢?? Vermicomposting equipments, devices Ã¢?? Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle) Ã¢?? vermicastings in organic farming/horticulture - Marketing the products of vermiculture Ã¢?? quality control, market research, marketing techniques Ã¢?? Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Ã¢?? Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times Ã¢?? Scientists Hope to Cultivate and Immune System for Crops

15GE0XH AGRICULTURE FOR ENGINEERS 1 0 0 1

Course Objectives

- To impart the basic knowledge of agricultural and horticultural crops, cropping systems
- To study the weed and nutrient management, irrigation water requirement and its quality

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the science of Agriculture
2. Summarize and apply the methodologies needed in agriculture based on the field conditions.

3. Develop enough confidence to identify the crop patterns in real world and offer appropriate solutions

UNIT I **5 Hours**

AGRONOMICAL PRACTICES AND CROPS

Definition and scope of agronomy , Classification of Crops, agricultural and horticultural crops Effect of Different Weather Parameters on Crop Growth and Development , Principal of Tillage, Tilth and Its Characteristics, Role of Water in Plant and Its Absorption, Conduction and Transpiration of Water and Plant Processes, Soil Water Extraction Pattern and Plant Response. Introduction to weeds, Weeds Control.

UNIT II **5 Hours**

CROP ROTATION, CROPPING SYSTEMS, RELAY AND MIXED CROPPING

Crop Rotation, Different Cropping Systems Ã¢?? I, Different Cropping Systems Ã¢?? II, Scope of Horticultural Crops, Soil Requirement for Fruits, Vegetables and Flowers Crops, Climatic Requirement for Fruits, Vegetables and Flowers Crops.

UNIT III **5 Hours**

PLANT NUTRIENTS

Essential Plant Nutrients, Nutrient Deficiency, Toxicity and Control Measures. Chemical fertilizers, fertilizer Reaction in Soil and Use Efficiency

UNIT IV **5 Hours**

QUALITY OF IRRIGATION WATER AND IRRIGATION METHODS

Quality of Irrigation Water, Poor Quality of Irrigation Water and Management Practices. Surface Irrigation methods, and micro irrigation methods

Total: 20 Hours

Reference(s)

1. SP. Palaniappan, and S. Sivaraman, Cropping systems in the tropics- Principles and Management, New Age international publishers, New Delhi, (2nd edition), 1998.
2. S.Sankaran and V.T Subbaiah Mudaliar, Principles of Agronomy, The Bangalore Printing and Pubg Co, Bangalore, 1993.
3. P.Balasubramain and SP. Palniappan, Principles and Practices of Agronomy, Agrobios publishers, Ludhiana, 2001.
4. T.Yellamanda Reddy and G.H. Sankara Reddi, Principles of Agronomy, Kalyani publishers, Ludhiana, 2005
5. B.Chandrasekaran, B. , K. Annadurai and E. Somasundaram, A Text book of Agronomy, Scientific publishers, Jodhpur, 2007
6. George Acquaah, Horticulture-principles and practices, Prentice-Half of India Pvt. Ltd., New Delhi, 2002.

15GE0XI INTRODUCTION TO DATA ANALYSIS USING SOFTWARE

1 0 0 1

Course Objectives

- To familiarize students on the features of MS Excel
- To enable the students to use Excel in the area of critical evaluation.
- To Facilitate the student to construct graphs

Programme Outcomes (POs)
Course Outcomes (COs)

1. Create versatile Excel document.
2. Apply built in functions for data analysis.
3. Prepare dynamic Charts

UNIT I **4 Hours**

EXCEL FUNDAMENTALS AND EDITING

Starting and Navigating a WorksheetÃ¢?? Entering Information Ã¢?? Hyperlinks Ã¢?? Saving Ã¢?? Editing Techniques Ã¢?? Entering a Series of Labels, Numbers and Dates Ã¢?? Checking Errors.

UNIT II **4 Hours**

FORMATTING

Formatting Cells Ã¢?? Changing Column Widths and Row Heights Ã¢?? Creating Conditional Formatting Ã¢?? Using Styles Ã¢?? Creating and Modifying Templates Ã¢?? Changing Page Breaks.

UNIT III **4 Hours**

POWER ORGANIZING AND CUSTOMIZING EXCEL

Managing Worksheets Ã¢?? Referencing Cells in Other Worksheets Ã¢?? Using More than One Work Book Ã¢?? Managing Shared Work Books Ã¢?? Protecting Worksheets and Workbooks. Adjusting Views Ã¢?? Setting Printing Options Ã¢?? Using Multiple Panes Ã¢?? Customizing Excel Using the Options Dialog Box.

UNIT IV **5 Hours**

CRUNCHING NUMBERS

Building a Formula Ã¢?? Using Basic Built-in Functions Ã¢?? Using Functions to Analyze Data Ã¢?? Using Names in Functions Ã¢?? Array Functions

UNIT V **3 Hours**

WORK SHEET CHARTS

Planning a Chart Ã¢?? Creating Chart Ã¢?? Formatting a Chart Ã¢?? Adding Labels and Arrows

Total: 20 Hours

Reference(s)

1. Michael J. Young, Michael Halvorson, Ã¢??Office System 2007 EditionÃ¢??, Prentice-Hall of India (P) Ltd., New Delhi, 2007
2. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007
3. Mark Dodgeand Craig Stinson, Ã¢??Microsoft Office Excel 2007 Inside OutÃ¢??, Microsoft Press, 2007

15GE0XJ ANALYSIS USING PIVOT TABLE 1 0 0 1

Course Objectives

- To familiarize students on the features of Pivot Table.
- To enable the students to use Pivot Table in the area of data analysis.
- Facilitate the student to construct the charts for visualization of data

Programme Outcomes (POs)
Course Outcomes (COs)

1. Able to construct the Pivot Table and Group, Sort, Filter the Data to do the analysis.

2. Able to do the Calculation with in Pivot Table for advance analysis.
3. Capable of Constructing Pivot Charts to make visual presentation

UNIT I **4 Hours**

PIVOT TABLE FUNDAMENTALS

Introduction about Pivot Table, Why and When to use the Pivot Table, Anatomy of the Pivot Table, Limitations, Preparing the Source Data, Creating the Pivot Table.

UNIT II **4 Hours**

GROUPING PIVOT TABLE DATA

Grouping the Items in a Report Filter, Grouping Text Items, Grouping Dates by Month, Grouping Dates Using the Starting Date, Grouping Dates by Fiscal Quarter, Grouping Dates by Week, Grouping Dates by Months and Weeks, Grouping Dates in One Pivot Table Affects Another Pivot Table, Grouping Dates Outside the Range.

UNIT III **4 Hours**

SORTING AND FILTERING PIVOT TABLE DATA

Sorting a Pivot Field: Sorting Value Items, Sorting Text Items, Sorting Items in a Custom Order. Filtering a Pivot Field: Manual Filter, Label Filter, Value Filter, Multiple Filters

UNIT IV **5 Hours**

CALCULATIONS WITHIN THE PIVOT TABLES

Using Formulae: Creating a Calculated Field with and without Ã¢??IF Condition, Calculated Item, Using Custom Calculations: % of Column, % of Row, % of Total, % Of, Running Total, Difference From, % Difference From, Index

UNIT V **3 Hours**

PIVOT CHARTS

Creating a Normal Chart from Pivot Table Data, Filtering the Pivot Chart, Changing the Series Order, Changing Pivot Chart Layout Affects Pivot Table, Changing Number Format in Pivot Table Affects Pivot Chart, Converting a Pivot Chart to a Static Chart, Refreshing the Pivot Chart, Creating Multiple Series for Years

Total: 20 Hours

Reference(s)

1. Debra Dalgleish, Ã¢??Excel 2007 - PivotTables Recipes A Problem-Solution ApproachÃ¢??, Apress, 2007, (ISBN-13 (pbk): 978-1-59059-920-4)
2. Bill Felen and Michael Alexander, Ã¢??Pivot Table Data Crunching for Microsoft Office 2007Ã¢??, Pearson Education, Inc., QUE Series.
3. Wayne L. Winston, Ã¢??Microsoft Office Excel 2007: Data Analysis and Business ModelingÃ¢??, Microsoft Press, 2007
4. John Walkenbach, Ã¢??Microsoft Office Excel 2007Ã¢??, Wiley Publishing, Inc. 2007
5. Mark Dodgeand Craig Stinson, Ã¢??Microsoft Office Excel 2007 Inside OutÃ¢??, Microsoft Press, 2007
6. Curtis D. Frye, Microsoft Office Excel 2007 Step by Step, Microsoft Press, 2007

15GE0XN JOURNALISM AND MASS COMMUNICATION 1 0 0 1

Course Objectives

- To offer a basic knowledge of mass communication and its various forms
- To provide a basic understanding of mass communication in India

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the underlying principles of Journalism
2. Understand the importance, functions & scope of mass communication
3. Follow and adapt to the periodic changes in media

UNIT I **15 Hours**

JOURNALISM AND MASS COMMUNICATION

What is News - Components of a Newspaper - Structure of an Article - How to Write Headlines - Introduction to Script Writing - News Reporting - Advertising and Marketing - Online Journalism - Rules of Editing - Proof Reading - Optimization and Key Words - Media Ethics - TV Studies - Media Propaganda - Identifying Fake News - International Communication

Total: 15 Hours

Reference(s)

1. Kumar, Keval. Mass Communication in India. IV Ed. Jaico Publishing House: 2012
2. Agarwal, S.K. A Handbook of Journalism & Editorial Excellence. Jaico Publishing House: 2012

15GE0XO VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of film making as an art, and video production
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

UNIT I **15 Hours**

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Ã¢?? Cinema as a visual medium -Significance of Editing Ã¢?? Styles of Editing Ã¢?? Editing as a methodology (HollywoodÃ¢??s Invisible Editing) Ã¢?? Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Ã¢?? Different types of shots and angles Ã¢?? Film style and Narrative Ã¢?? (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema

etc.,) Ã¢?? Regional Cinema to National CinemaÃ¢?? Basics of Script Writing (Double and Single Column) Ã¢?? Basics of Video Production (script to screen) Ã¢?? Final submission of a script for five minutes short film

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009
2. Belavadi, Vasuki, Video Production. India: OUP, 2013

15GE0XP YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga Ã¢?? History of Yoga - Yoga in todayÃ¢??s scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - MudrasRelaxation - Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009
3. Ramesh Partani, The Complete Secret, Ru Education, 2013
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

15GE0XQ CARNATIC MUSIC 1 0 0 1

Course Objectives

- To know the basics of Carnatic Music
- To foster a blend of practical and theoretical understanding of Carnatic Vocal music
- To give a brief understanding of History of Indian Music, Evolution of the Raga system, Tala system, Structure of compositions

Programme Outcomes (POs)
Course Outcomes (COs)

1. Develop an understanding of the basics of Carnatic music

2. Understand the aspects of Carnatic music which will help to create a strong foundation in Carnatic Music

UNIT I **15 Hours**

CARNATIC MUSIC

History of Carnatic music - History of Carnatic Composers - Music Technical Terms Part I: Music, Nadam, Sangeetham, Marga Sangeetham, Suddha Sangeetham, Desiya Sangeetham, Kalpita, Kalpana, Ahata Nadam, Anahata Nadam, Shruthi, Swaram, Swarasthanas, Seven Swaras, Tamil Swaras, Prakruthi, Vikruthi, Kamala, Tivra, Twelve Swaras, Arohanam, Avarohanam, Swarna Kalas, Thala Symbols, Sthayi - Music Technical Terms Part II: Ragas, Janaka Ragas, Janya Ragas, Melakartha Ragas, Upanga Ragas, Bhashanga Ragas, Akshara Kalas, Sangathi, Anya Swaram, Chakras and Meanings, Jaaru, Poorvangam, Thadu and Madu, Saptaham, Ashtakam, Uthrangam, Gamaga, Abhyasa Ghanam, Sapta Kriyas, Nisapta Kriyas, Three Sathanas, Sabahaa gananas, Alapana, Thala, Laghu, Dhrutham - Jantavarisai - Classification

Total: 15 Hours

Reference(s)

1. Bhagyalekshmy, S. Ragas in Carnatic Music. CBH Publications, 2003
2. Deva, Bigamudre Chaitanya. An Introduction to Indian Music. Publications Division, Ministry of Information and Broadcasting, Government of India, 2015
3. Sambamoorthy, P. South Indian Music. Indian Music Pub. House, 1954

15GE0XR GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology
- Defining Psychology and the subject matter of psychology
- To provide an awareness of various methods and branches of psychology
- To explain social and work psychology of people and the need for mental health

Programme Outcomes (POs)

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the different fields of psychology and its uses
3. Deal people effectively in their personal and social life

UNIT I **15 Hours**

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016

4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993

15GE0XS NEURO BEHAVIOURAL SCIENCE 1 0 0 1

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages
- To provide an understanding of the Cognitive processes

Programme Outcomes (POs)
Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health
2. Value ethical conduct in professional and personal life
3. Recognize the need for rationale and evidence in decision-making

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

15GE0XT INNOVATION AND ENTREPRENEURSHIP 1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)
Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification Ã¢?? ideation -MVPPositioning as an Entrepreneur Ã¢?? Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup Ã¢?? Types of startups and licensing

systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources Ã¢?? VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Ã¢?? Sustainability - Exit strategies and Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Ã¢??Business stripped bareÃ¢??, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011.