DEPARTMENT OF FOOD TECHNOLOGY

B.TECH FOOD TECHNOLOGY

CURRICULUM & SYLLABUS
REGULATIONS 2015

KALASALINGAM UNIVERSITY

(Kalasalingam Academy of Research and Education)
(Under Section 3 of the UGC Act 1956)
Anand Nagar, Krishnankoil-626190 Srivilliputhur (via);
Virudhunagar (Dt.), Tamil Nadu, INDIA
(www.klu.ac.in)

Institute Vision	Institute Mission
To be a University of Excellence of International Repute in Education and Research.	1. To provide a scholarly teaching-learning ambience which results in creating graduates equipped with skills and acumen to solve real-life problems. 2. To promote research and create knowledge for human welfare, rural and societal development. 3. To nurture entrepreneurial ambition, industrial and societal connect by creating an environment through which innovators and leaders emerge.
Department Vision	**Department Mission**
To be a center of repute in the frontier areas of Food Technology through quality research and education.	1. To impart knowledge in the realm of food technology through research and education. 2. To nurture professional leaders in the field of food technology with entrepreneurship skills. 3. To cultivate strong ethical values for sustainable growth in food processing to fulfill the needs of the society

Program Educational Objectives (B.Tech – Food Technology)

PEO 1	The graduates will exhibit competence as professionals in academic and research in food processing industry or related disciplines through professional development.
PEO 2	The graduates will have acumen to be a successful entrepreneur in areas related to food and allied technologies.
PEO 3	The graduates will promote ethics, sustainability and environmental responsibility in their practice.

Programme Specific Outcomes (B.Tech – Food Technology)

A graduate of the Food Technology program will demonstrate:

PSO1	Professional Skills: The ability to understand, evaluate and prepare ways to process, preserve, package, or store food, according to industrial requirements.
PSO2	Problem Solving Skills: The ability to apply standard practices and regulation in developing the food and allied products.
PSO3	Career and Entrepreneurship: The ability to employ modern technologies to produce new or value added products in the area of Food Technology.

Curriculum Structure

S. No.	Category		Credits
I	Basic Sciences and Mathematics		25
II	Humanities and Social Sciences		16
	English for Technical Communication	4	
	Soft Skills	3	
	Humanities Elective	9	
III	Basic Engineering		14
IV	**Program Core**		103
	a) Core Courses	90	
	b) Community Service Project	3	
	c) Project Work	10	
V	**Elective Courses**		24
	a) Professional Elective	18	
	b) Open Elective	6	
Total			182

Program Outcomes	
Graduates will be able to	
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**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.
PO 3	**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.
PO 4	**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.
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities
PO 6	**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.
PO 7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for
PO 8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**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
PO 11	**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.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in
PO13	**Professional Skills:** The ability to understand, evaluate and prepare ways to process, preserve, package, or store food, according to industrial requirements.
PO14	**Problem Solving Skills:** The ability to apply standard practices and regulation in developing the food and allied products.
PO15	**Career and Entrepreneurship:** The ability to employ modern technologies to produce new or value added products in the area of Food Technology.

SEMESTER I

Course Code	Course Title	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
HSS101	English for Technical	1	9, 10	2	0	0	2
MAT103	Mathematics I	1	1, 2	3	0	0	3
PHY131	Physics I	1,3	1, 2	3	0	0	3
CHY106	Chemistry	1,3	1, 2	3	0	0	3
CSE102/ MEC101	Programming Languages/ Engineering Drawing	1 /1,2,3	1, 3,15	2	0	0	2
EEE101/ CIV101	Basic Electrical and Electronics Engineering/ Basic Civil and Mechanical Engineering	1,3/1,3	1, 2, 3, 5, 6,7	4	0	0	4
PHY183/ CHY182	Physics Laboratory/ Chemistry laboratory	1,2,3/1,2,3	1,2	0	0	3	1
CSE181/ MEC181	Programming Languages Laboratory/ Work shop	1,2,3/1,3	1,2,3 5/ 1, 3,5, 15	0	0	3	1
	Total			**17**	**0**	**6**	**19**

SEMESTER II

Course Code	Course Title	Objectives & Outcomes		L	T	P	C
		PEOs	POs				
HSS102	English for Technical Communication II	2	9,10	2	0	0	2
MAT104	Mathematics II	1	1,2	3	0	0	3
PHY132	Physics II	1,3	1,2	3	0	0	3
CIV101/ EEE101	Basic Civil and Mechanical Engineering/ Basic Civil and Mechanical Engineering	1,2/ 1,2	1, 2, 3, 5, 6,7	4	0	0	4
CHY102	Environmental Sciences	1,2,3	7	2	0	0	2
CSE102/ MEC101	Programming Language/ Engineering Drawing	1/ 1,2,3	1, 3,5	2	0	0	2
FBT101	Biochemistry of Food	1	1,2, 4, 13,14	3	0	0	3
CSE181/ MEC181	Programming Language Lab/ Laboratory Workshop	1/1	1, 3,5, 15/ 1,2,3 5	0	0	3	1
CHY182/ PHY183	Chemistry Laboratory/ Physics Laboratory	1,2,3/ 1,2,3	1,2/ 1,2	0	0	3	1
HSS036	Soft Skills -I	2	10	2	0	0	1
	Total			**21**	**0**	**6**	**22**

SEMESTER III

Course Code	Course Title	Prerequisite	Objectives & Outcomes		L	T	P	C
			PEOs	POs				
MAT202	Mathematics III		1	1,2	3	0	0	3
FBT201	Food microbiology		1,2	1, 2, 4,6,7,13,14	3	0	0	3
CHE254	Principles of Chemical Engineering		1,2	1,2, 4, 7,13,15	3	1	0	4
FBT202	Principles of Food Processing and Preservation		1,2,3	1, 2, 4, 6,7,13, 14,15	3	0	0	3
FBT203	Dairying and Dairy Products		1,2	1, 2, 4, 6,7,13, 14,15	3	0	0	3
FBT204	Food Additives		1,2	1,2,4,6,14 ,13	3	0	0	3
FBT281	Food Biochemistry Laboratory	FBT101	1,2,3	1,2, 4, 13,14	0	0	3	2
FBT282	Food Microbiology laboratory		1,2,3	1, 2, 4,6,7,13,14	0	0	3	2
FBT283	Food Preservation and Processing Laboratory – I		1,2,3	1, 2, 4,5, 6,7,13, 14,15	0	0	3	2
HSS037	Soft Skills-II		1,3	10	2	0	0	1
	Total				**20**	**1**	**9**	**26**

SEMESTER IV

Course Code	Course Title	Prerequisite	Objectives & Outcomes		L	T	P	C
			PEO	PO				
HSSXX	Humanities Elective I		1,2	8, 9,10, 11	3	0	0	3
MAT251	Biostatistics		1	1,2,4	3	0	0	3
CHE255	Unit Operations in Food Processing		1,2	1,2, 4, 7,13,15	3	0	0	3
FBT205	Instrumental Methods of Analysis for Food		1,2	1,2	3	0	0	3
FBT206	Fermentation Biotechnology		1	1,2,6, 7,13	3	0	0	3
FBT207	Nutraceuticals and Functional Foods		1	1,2, 6,13	3	0	0	3
FBT208	Technology of Animal Foods		1	1,2,3 13	3	0	0	3
FBT284	Fermentation Technology Laboratory	FBT282	1,2	1,2,6,7,13	0	0	3	2
FBT285	Instrumental Methods of Analysis Lab – I		1,2,3	1,2,5,6	0	0	3	2
CHE292	Unit Operations in Food Processing Laboratory		1,2	1,2, 4,5 7,13,15	0	0	3	2
HSS038	Soft Skill –III		1,2	10	2	0	0	1
	Total				**23**	**0**	**9**	**28**

SEMESTER V

Course Code	Course Title	Prerequisite	Objectives & Outcomes		L	T	P	C
			PEO	P				
FBTXXX	Major Elective I		1	2,4,13	3	0	0	3
	Minor Elective I		1	2,4,13	3	0	0	3
CHE353	Heat and Mass Transfer		1	1,2, 4,7, 13, 15	3	1	0	4
FBT301	Crop Processing Technology		1	1,2,3,	3	0	0	3
FBT302	Optimization techniques in Food		1,2	1,2,4	3	1	0	4
FBT304	Traditional & Fermented Foods		1, 2	1,2, 6,13	3	0	0	3
FBT381	Food Preservation and Processing Laboratory – II	FBT282	1, 2	1, 2, 4,5, 6,7,13, 14,15	0	0	4	2
CHE391	Mass Transfer Operations Laboratory		1	1,2, 4,5,7, 13,15	0	0	4	2
FBT 384	Community Service Project Phase-I		2, 3	3,6, 7	0	0	2	1
	Total				**18**	**2**	**10**	**25**

SEMESTER VI

Course Code	Course Title	Prerequisite	Objectives & Outcomes		L	T	P	C
			PEOs	POs				
FBTXXX	Major Elective II		1	2, 4, 13	3	0	0	3
HSSXXX	Humanities Elective II		1	8, 9, 10, 11	3	0	0	3
	Free Elective I		1	1,2,6	3	0	0	3
	Minor Elective II		1	2, 4, 13	3	0	0	3
FBT305	Food Process Equipment Design		1,2	2,3, 4	3	0	0	3
FBT306	Food Quality Control		1,2	1,2,4,6,14,13	3	0	0	3
FBT307	Food Packaging Technology	FBT202	1, 2, 3	1, 2, 4, 6,7,13, 14,15	3	0	0	3
FBT382	Food Process Equipment Design and Drawing laboratory		1,2	2,3, 4,5	0	0	4	2
FBT383	Food Quality Evaluation Laboratory		1, 2	1,2,4,6,14,13	0	0	4	2
FBT385	Community Service Project Phase-II		2&3	3,6, 7	0	0	3	2
	Total				**21**	**0**	**11**	**27**

SEMESTER VII

Course Code	Course Title	Prerequisite	Objectives & Outcomes		L	T	P	C
			PEOs	POs				
HSSXXX	Humanities Elective III		1, 2	8, 9, 10, 11	3	0	0	3
	Free Elective II		1	1,2,6	3	0	0	3
FBTXXX	Major Elective III		1	2, 4, 13	3	0	0	3
FBTXXX	Major Elective IV		1	2, 4, 13	3	0	0	3
CHE451	Instrumentation and Process Control		1	1, 2,13	3	0	0	3
FBT401	Refrigeration and Air conditioning	CHE353	1,3	1,2,3	3	0	0	3
FBT491	Food Engineering Laboratory		1,2	1,2,3,4,5, 13,14,15,	0	0	4	2
CHE491	Process Control Laboratory		1	1, 2, 3,5,13	0	0	4	2
	Total				**18**	**0**	**8**	**22**

SEMESTER VIII

Course Code	Course Title	Objectives &		L	T	P	C
		PEOs	POs				
FBTXXX	Self-study Elective	1	1 3	3	0	0	3
FBT499	Project Work	1,2,3	1,2,3,4,5,6,7,8,9 ,10,11,12,13,14, 15	0	0	26	10
	Total			**3**	**1**	**26**	**13**

Total Credits from 1st Semester to 8th Semester = 182

LIST OF ELECTIVES FOR THIRD YEAR

Course Code	Course Title	L	T	P	C
FBT308	Composition, Quality & Safety of Foods	3	0	0	3
FBT309	Sugarcane Technology	3	0	0	3
FBT310	Beverage Technology	3	0	0	3
FBT311	Bakery and Confectionary Technology	3	0	0	3
FBT312	Metabolism & Nutrition	3	0	0	3
FBT313	Food Process Management	3	0	0	3
FBT314	Food Process Modeling	3	0	0	3
FBT315	Cereals, Pulses & Oilseed Products	3	0	0	3
FBT316	Lipid Science	3	0	0	3
FBT317	Protein Chemistry and Technology	3	0	0	3

LIST OF ELECTIVES FOR FOURTH YEAR

Course Code	Course Title	Prerequisite	L	T	P	C
FBT402	Public Health Engineering		3	0	0	3
FBT403	Oils and Fats Processing Technology		3	0	0	3
FBT404	Egg, Poultry, Meat and Fish Processing Technology	FBT208	3	0	0	3
FBT405	Fruits, Vegetables and Plantation Products		3	0	0	3
FBT406	Post-Harvest Pest and Disease Management in Food		3	0	0	3
FBT407	Technology of Expanded and Extruded Food Products		3	0	0	3
FBT408	Food Plant Layout and Design		3	0	0	3
FBT409	Milling Technology for Food Materials		3	0	0	3
FBT410	Engineered, Texturised & Fabricated Foods		3	0	0	3
FBT411	Food Quality & Food Laws		3	0	0	3

LIST OF MINOR ELECTIVES

Course Code	Course Title	L	T	P	C
CHE363	Process economics and plant design for food engineers	3	0	0	3
CHE364	Simulation of flow patterns in Food Process Equipment	3	0	0	3
CHE365	Novel Separation Techniques.	3	0	0	3
CHE359	Transport phenomenon in food processing	3	0	0	3
CHE360	Rheology & Texture Analysis	3	0	0	3
CHE361	Food plant safety and hazard analysis	3	0	0	3
CHE362	Pollution Control in Food Industries	3	0	0	3
CHE314	Colloids and surface science	3	0	0	3
CHE323	Membrane Science and Technology	3	0	0	3
CHE410	Finite element Methods	3	0	0	3

LIST OF HUMANITIES ELECTIVES

Course	Course Title	L	T	P	C
HSS001	Total Quality Management	3	0	0	3
HSS002	Engineering Management	3	0	0	3
HSS004	Industrial Psychology	3	0	0	3
HSS005	Consumer Psychology	3	0	0	3
HSS006	Professional Ethics	3	0	0	3
HSS007	Operations Management	3	0	0	3
HSS008	Introduction to Economics	3	0	0	3
HSS010	International Trade and Finance	3	0	0	3
HSS011	Information Systems for Managerial Decision Making	3	0	0	3
HSS013	Cost Analysis and Control	3	0	0	3
HSS014	Introduction to Marketing Management	3	0	0	3
HSS017	International Economics	3	0	0	3
HSS018	Communication Skills	3	0	0	3
HSS016	Organizational Psychology	3	0	0	3
HSS023	Entrepreneurship Development	3	0	0	3
HSS025	Science Fiction: An Appreciation	3	0	0	3
HSS026	German – I	3	0	0	3
HSS028	French – I	3	0	0	3
HSS030	Science Technology and Medicine in India: A Historical Perspective	3	0	0	3
HSS022	Banking Theory and Practice	3	0	0	3
HSS033	Modern Science in India	3	0	0	3
HSS035	History of Science and Technology	3	0	0	3
HSS032	Food Processing Enterprise	3	0	0	3

BASIC SCIENCES AND MATHEMATICS

PHY131	PHYSICS – I				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Basic sciences and mathematics			
			Course Type	**:**	Theory Course			

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understanding the different types of sound waves and production & application of ultrasonics.

CO2: Understanding the basic concepts, production & applications of different types of laser sources.

CO3: To know the general ideas about optical fibres and their applications in various fields.

CO4: Learning the basic knowledge of crystallography and it's preparation techniques.

CO5: To gain the knowledge about the fundamentals, theory of quantum physics

Mapping of course outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M													
CO2	H	M											1		
CO3	H	M													
CO4	H	M											1		
CO5	H	M											1		

Unit 1: ACOUSTICS AND STRUCTURE OF SOLIDS 9 Hours

Classification of sound – reverberation – Sabine‟s formula – common acoustical defects and remedies – classification of solids – crystal structures – X-ray diffraction – crystal growth – crystal defects.

Unit 2: LASER AND FIBRE OPTICS 9 Hours

Interaction of radiation with matter – quantum mechanical view –three and four Level laser system- Holography- construction and teconstruction of hologram – Engineering and medical applications – introduction of fibre optics –classification of fibre- Engineering and medical applications

Unit 3: QUANTUM PHYSICS 9 Hours

Inadequacy of classical mechanics –Blackbody radiation –Planck‟s law –Photo electric effect – Compton effect –Einstein‟s photoelectric equation –Schrodinger wave equation –particle in one-three dimensional box.

Unit 4: NON-DESTRUCTIVE TESTING 9 Hours

Liquid penetrant – magnetic particle and eddy current methods – X-ray radiography – fluoroscopy- Gamma ray radiography – ultrasonic scanning methods – ultrasonic flaw detector – thermography

Unit 5: RELATIVITY **9 Hours**

Frame of reference – Newtonian relativity – Galilean Transformation equations – Ether hypothesis-Michelson-Morley experiment – special theory of relativity – Lorentz transformation equations – length contraction – time dilation – relativity of simultaneity – addition of velocities – variation of mass with velocity - mass-energy equivalence – Minkowski‟s four dimensional space – time continuum.

Text Book(s):

1. P.K. Palanisamy, “Engineering Physics”, Scitech Publications (India), Pvt Ltd., Chennai, 2009.
2. S.O. Pillai and D.N. Sankar, A text book of Engineering Physics. New Age International Publication, New Delhi, 2008.

Reference Books:

1. Murthy V.S.R., Jena AK, Gupta K.P. and Murthy G.S., Structures and Properties of Engineering Materials, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2003.
2. Gaur R.K. & Gupta S.L., Engineering Physics, Dhanpat Rai publications (P) Ltd., New Delhi, 2001. Ali Omar. M, Elementary Solid State Physics, Pearson Education (Singapore), Indian Branch, New Delhi.
3. William F. Smith, Foundations of materials science and Engineering, 3rd Edition, Tata McGraw-Hill, New York, 2003.
4. Rajput B.S Pragati Prakashan, Advanced Quantum Mechanics, New Market, Begum Bridge, Meerut.
5. Hand book of Electronics, Gupta S.L. Kumar V Pragati Prakashan, New Market, Begum Bridge, and Meerut.
6. Arthur Beiser, Concepts of Modern Physics - Tata McGraw – Hill Publishing Company Limited, New Delhi, 5th Edition, 2000.

CHY106	CHEMISTRY				L	T	P	C
					3	1	2	5
Pre-Requisite	:	NIL	Course Category	:	Basic sciences and mathematics			
			Course Type	:	Integrated Course			

Course Outcomes:

CO1: Know the water quality parameters to assess the quality of water
CO2: Learning the techniques of purification of water
CO3: Gathering the knowledge in basic concepts of thermodynamics
CO4: Explain the principles of chemical & electrochemical reactions and prevention of corrosion of materials
CO5: Principles and generation of energy in batteries, solar cells and fuel cells

Mapping of course outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M			M								L		
CO2	H	M			M								L		
CO3	H	M													
CO4	H	M											L		
CO5	H	M													

Unit 1: MACROSCOPIC PROPERTIES OF SYSTEMS IN EQUILIBRIUM 9 Hours

Basic concepts of thermodynamics- Mathematical form of First law and its limitations- Enthalpy- Applications of first law (relation between Cp and Cv only) - Second law of thermodynamics (Clausius and Kelvin statement) - Entropy changes for reversible and isothermal processes - Problems-Entropy of phase transitions-Problems- Free energy and work function, Gibbs-Helmholtz equation- Applications-Problems-Van"t Hoff isotherm and isochore-Applications-Problems- Phase equilibria- Application to one component systems, two component systems (eutectic and compound formation).

Unit 2: ELECTRODICS 9 Hours

Electrochemical series and its applications -Reference electrodes (H2 and calomel electrodes)- Determination of single electrode potential by using reference electrodes - -EMF measurements and its applications-problems- Nernst equation-Problems- Electrochemical energy systems: primary and secondary batteries, fuel cells, solar cell- Chemical structure, electronic behaviours and applications of conducting polymers.-Principles of chemical and electrochemical corrosion - Corrosion control (Sacrificial anode and impressed current methods)

Unit 3: DYNAMICS OF CHEMICAL PROCESSES 9 Hours

Basic concepts- Kinetics of parallel, opposing and consecutive reactions with examples- Temperature dependence of rate of reactions-Problems -Techniques and methods for fast reactions, flow techniques, relaxation methods and flash photolysis - Thermodynamic formulation of reaction rates - Enzyme kinetics (Michaelis-Menten equation).

Unit 4: WATER TECHNOLOGY 9 Hours

Water quality parameters - Definition and expression - Importance and determination of Dissolved oxygen (DO) content in water-Estimation of hardness (EDTA method)- Problems- Determination of alkalinity- Water softening (zeolite) - Demineralisation (Ion- exchangers) and desalination – Boiler feed water-Domestic water treatment.

Unit 5: INSTRUMENTAL METHODS OF ANALYSIS 9 Hours

Fundamental principles, theory, instrumentation and applications of UV-Visible spectroscopy, Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), Thermogravimetric analysis (TGA), Differential Thermal Analysis (DTA), Scanning Electron Microscopy (SEM), Tranmission Electron Microscopy (TEM), Refractometry and Nephelometry.

Text Books

1. Atkins P. W., Physical Chemistry, Sixth Edition, Oxford University Press, 1998.
2. Jain P.C. and Monica J., " Engineering Chemistry ", Dhanpat Rai Publications Co.,(P) Ltd., New Delhi, 14th Edition 2002.
3. Sharma, B.K., "Instrumental Methods of Analysis ", Goel publishing House, 12th Edition, 2001.

Reference Books

1. Puri B.R., Sharma L.R., and Pathania M.S., “Principles of physical chemistry”, Vishal publishing Co.,2008
2. Kuriakose,J.C. and Rajaram J., “Chemistry in Engineering and Technology”, Vol. I and II, Tata McGraw-Hill Publications Co, Ltd, New Delhi, 1996
3. Kund and Jain, “Physical Chemistry ", S. Chand and Company, Delhi, 1996.
4. Gordon M.Barrow, “Physical Chemistry ", Sixth Edition, Tata McGraw Hill, 1998.
5. Willard, H.H., Merritt. I.I., Dean J.A., and Settle, F.A., "Instrumental methods of analysis", Sixth Edition, CBS publishers, 1986.
6. Vogel A.I., “Quantitative Inorganic Chemical Analysis ", V. Edition, 1989.
7. Rouessac, F., “Chemical Analysis -Modern instrumental methods and techniques ", Wiley-Publishers, 1999.

PHY132	PHYSICS II				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	**Course Category**	:	Basic sciences and mathematics			
			Course Type	:	Theory			

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understanding the free electron theories, formation of energy bands, energy distribution and also the electron behavior in solids

CO2: Ability to know and understand the cooper pair electron behavior, applications of superconducting materials in developing technologies.

CO3: To learn the importance of semiconducting materials in engineering fields by projecting the view of energy bands.

CO4: To gain the knowledge about various kinds of magnetic materials, their properties and applications in advanced technologies.

CO5: To gain the knowledge about dielectric materials, their properties and significant applications in advanced technologies.

Mapping of course outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H												L		
CO2	H														
CO3	H												L		
CO4	H														
CO5	H												L		

Unit 1: CONDUCTING MATERIALS 9 Hours

Conduction in metals – mobility and conductivity – classical free electron theory - electrical conductivity – thermal conductivity – Wiedemann-Franz law – Lorentz number-drawbacks of classical theory.

Unit 2: SEMICONDUCTING AND SUPERCONDUCTING MATERIALS 9 Hours

Introduction semi conducting materials – types of semiconducting materials – carrier concentration – Hall effect – determination of Hall coefficient – superconducting phenomena – properties of superconductors – Type I and Type II superconductors – high Tc superconductors – application of super conductors.

Unit 3: MAGNETIC MATERIALS 9 Hours

Classical theory of magnetism – quantum theory of paramagnetism – ferromagnetism – ferrites – applications of magnetic materials.

Unit 4: DIELECTRIC MATERIALS AND OPTICAL MATERIALS 9 Hours

Electronic, ionic, orientation and space charge polarization – internal field and deduction of Clausius-Mosotti relation – properties of dielectric materials – classification of insulating materials – optical properties of semiconductor – imperfection of crystals – luminescence – fluorescence – phosphorescence – light emitting diode (LED) – liquid crystal displays (LCD).

Unit 5: NEW ENGINEERING MATERIALS 9 Hours

Metallic glasses as transformer core material – nano phase materials – shape memory alloys – Bio materials (metals & alloys, ceramics) – non-linear materials – second harmonic generation – optical mixing - optical phase Conjugation – solitons and IC packaging materials.

Text Books:

1. P.K. Palanisamy, "Material Science", Scitech Publications (India), Pvt Ltd., Chennai, 2009.
2. Arumugam, M., Material Science, Anuradha Agencies, Kumbakonam, 3rd Edition, 2003.

Reference Books:

1. Aswani K.G., A Text book of Material Science, S.Chand & Co., Ltd., New Delhi, 2nd Edition, 2001.
2. Raghavan, V., Material Science and engineering, Prentice-Hall of India Pvt. Ltd., India.
3. William F.Smith, Foundations of Materials Science and Engineering, McGraw-Hill, New York, 3rd Edition, 2003.
4. Wahab M.A., Solid State Physics, Narosa Publishing House, New Delhi, 1999.
5. Pillai S.O., Solid State Physics, New Age International Publication, New Delhi, 5th edition, 2003.
6. Ali Omar.M, Elementary Solid State Physics, Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2002.
7. Murthy V.S.R., Jena AK, Gupta K.P. and Murthy G.S., Structure and Properties of Engineering Materials, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2003

PHY183	PHYSICS LABORATORY				L	T	P	C
					0	0	3	1
Pre-Requisite	:	NIL	Course Category	:	Basic sciences and mathematics			
			Course Type	:	Laboratory			

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the practical understanding of the mechanical properties such as modulus, moment of inertia, gravitational force, stress, strain, etc

CO2: Understanding and applying the optical phenomena like diffraction, interference,etc.

CO3: Understanding the thermal conductivity and also thermal behavior of the specimen

CO4: Can acquire practical skill to analyze the fluid state mechanism

CO5: Ability to find thickness of very very thin objects

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H												L		
CO2	H														
CO3	H												L		
CO4	H	M	M												
CO5	H	M	M										L		

List of Experiments:

1. To determine the acceleration due to gravity using Compound Pendulum
2. To determine the Rigidity Modulus of wire using Torsional Pendulum
3. To find thickness of the given two glass plates using single optic lever.
4. To determine the thermal conductivity of a bad conductor
5. To determine the refractive index of the material of the prism.
6. To find the number of rulings per cm length of the given transmission grating.
7. To determine the particle Size Using Laser
8. To determine the coefficient of viscosity of the liquid by Poiseuille‟s method
9. To determine the young’s modulus of given material using Uniform Bending
10. To Determine the thickness of a given material using Air wedge method
11. To determine the focal length of a biconvex lens using Newton’s Rings method
12. To determine the velocity of ultrasonic waves in the given medium using ultrasonic Interferometer.

CHY182	CHEMISTRY LABORATORY				L	T	P	C
					3	1	0	4
Pre-Requisite	:	NIL	Course Category	:	Basic sciences and mathematics			
			Course Type	:	Laboratory			

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Analyze the various water quality parameters

CO2: Investigate the kinetics of a chemical reaction

CO3: Determine the amount of fluoride and iron by spectrophotometric methods

CO4: Estimate the amount of acid and base by electrochemical methods

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M												L	
CO2	M		M												
CO3	M	M													
CO4	M													L	
CO5	M														

List of Experiments:

1. Estimation of hardness of water sample by EDTA method
2. Determination of alkalinity of given water sample
3. Determination of dissolved oxygen in a water sample
4. Determination of rate constant of a reaction (Ester hydrolysis)
5. Estimation of hydrochloric acid by pH titration
6. Estimation of chloride ion in a given water sample
7. Determination of sodium and potassium by flame photometry
8. Estimation of ferrous ion by potentiometric method
9. Estimation of iron by spectrophotometry using 1,10-phenanthroline
10. Determination of strength of mixture of acids using strong base by conductometric titration
11. Estimation of fluoride ion by spectrophotometry
12. Conduct metric titration of strong acid with strong base

MAT103	MATHEMATICS -I			L	T	P	C
				3	0	0	3
Pre-Requisite : NIL	Course Category :	Basic sciences and mathematics					
	Course Type :	Theory					

Course Outcomes.:

CO1: Find the Eigen values of a matrix and to use Cayley-Hamilton theorem for finding the inverse of a matrix.
CO2: Explain the concept of curvature and to find envelope of a curve.
CO3: Apply partial derivatives to find maxima and minima.
CO4: Solve second order linear differential equations with constant coefficients, Cauchy's equation and Legendre's equation .
CO5: Understand the geometry of sphere, plane and straight line in the three dimensional space.

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M													
CO2	H	M													
CO3	H	M													
CO4	H	M												L	
CO5	H	M													

Unit 1: MATRICES **9 Hours**

Review of linear algebra - Matrix operations - Addition, scalar multiplication, multiplication, transpose, ad joint and their properties - Special types of matrices - Null, identity, diagonal, triangular, symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, orthogonal, unitary, normal - Rank - Consistency of a system of linear equations - Solution of the matrix equation Ax = b – Row - Reduced echelon form.

Unit 2: EIGEN VALUE PROBLEMS **9 Hours**

Eigen value and eigen vector of real matrix - properties of eigen values and eigen vectors - Cayley - Hamilton theorem - Orthogonal transformation of a real symmetric matrix to diagonal form - Reduction of quadratic form to canonical form by orthogonal transformation - Index, signature and nature of quadratic form.

Unit 3: DIFFERENTIAL CALCULUS **9 Hours**

Review of limits - Continuity and differentiability - Curvature - Cartesian and Parametric co-ordinates - Centre and radius of curvature - Circle of curvature - Evolutes - Involutes - Envelopes - Partial differentiation - Euler‟s theorem for homogeneous functions -Total differential - Taylor‟s expansion (two variables) - Maxima and Minima for functions of two variables - Method of Lagrangian multiplier – Jacobians

Unit 4: THREE-DIMENSIONAL ANALYTICAL GEOMETRY 9 Hours

Direction cosines and ratios - Angle between two lines - Equations of a plane - Equations of straight line - Coplanar lines - Shortest distance between two skew lines - Sphere - Tangent plane - Plane section of a sphere - Orthogonal spheres

Unit 5: ORDINARY DIFFERENTIAL EQUATIONS 9 Hours

Solutions of second and higher order linear ODE with constant coefficients - Cauchy‟s and Legendre”s linear equations - Simultaneous first order linear equations with constant coefficients - Method of variation of parameters

Text Books:

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edn., 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume I, Scitech Publications (India) Pvt. Ltd., Chennai, 2nd Edn., Reprint 2000, 1999

References

1. B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition., 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd Edition., Reprint 2001, 2000

MAT104	MATHEMATICS -II			L	T	P	C
				3	0	0	3
Pre-Requisite : NIL	Course Category :	Basic sciences and mathematics					
	Course Type :	Theory					

Course Outcome(s):

CO1: Explain the concept of double integral and triple integral.
CO2: Explain the concept of Gradient, divergence and curl.
CO3: Explain the concept of line, volume and surface integrals.
CO4: Construct conformal mappings between regions.
CO5: Evaluate certain real integrals using residue theorem.

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M											L		
CO2	H	M													
CO3	H	M											L		
CO4	H	M													
CO5	H	M													

Unit 1: SEQUENCES AND SERIES 9 Hours

Convergence and divergence of infinite series – series of positive terms – comparison, D"Alembert"s ratio, Raabe"s and Cauchy"s root tests – Convergence of alternating series – Leibnitz"s test (proof of theorems and tests not included) – elementary notions of absolute and conditional convergence - Power series – Taylor"s theorem(one variable)

Unit 2: ANALYTIC FUNCTION AND CONFORMAL MAPPING 9 Hours

Function of a complex variable – Analytic function – Necessary conditions – Cauchy – Riemann equations – Sufficient conditions (excluding proof) – Properties of analytic function – Harmonic conjugate – Construction of Analytic functions - Conformal mapping - $w = z+a$, az, $1/z$, e^z , sin z, cos z and bilinear transformation – fixed points – cross ratio

Unit 3: COMPLEX INTEGRATION 9 Hours

Statement and application of Cauchy"s integral theorem and integral formula – Taylor and Laurent expansions – Isolated singularities – Residues - Cauchy"s residue theorem - Contour integration over unit circle and semicircular contours (excluding poles on boundaries)- evaluation of real integrals using contour integration

Unit 4: MULTIPLE INTEGRALS 9 Hour

Review of Riemann integrals - Double integration – Cartesian and polar coordinates – change of order of integration – change of variable between Cartesian and polar – Area as double integral – Triple integration in Cartesian, cylindrical and spherical polar coordinates – volume as triple integral

Unit 5: VECTOR CALCULUS 9 Hours

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green‟s theorem in a plane, Gauss divergence theorem and Stoke‟s theorem (excluding proof) – Simple applications

Text Books

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edition, 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1st Edition., Reprint 2000, 1999

Reference Books

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition., 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd Edition., Reprint 2001, 2000
3. Venkataraman, M. K., Engineering Mathematics – III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998

MAT202	MATHEMATICS -III			L	T	P	C
				3	0	0	3
Pre-Requisite : NIL	Course Category :	Basic sciences and mathematics					
	Course Type :	Theory					

Course Outcome(s):

CO1: Evaluate integrals and solve boundary value problems using Laplace transfoms.

CO2: Solve standard type of first order partial differential equations and higher order partial differential equations with constant coefficients

CO3: Apply the concept of Fourier series to find the sum of certain series.

CO4: Solve difference equations using Z-transform

CO5: Find Fourier, Sine and Cosine transforms of given functions

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M												
CO2	H	M	M										L		
CO3	H	M	H												
CO4	H	M	H												
CO5	H	M	M												

Unit 1: LAPLACE TRANSFORM 9 Hours

Definition of Laplace transform - Linearity property - condition for existence of Laplace transform - First and second shifting properties - Laplace transform of derivatives and integrals - Unit step functions - Diarc delta-function - Differentiation and integration of transforms - Convolution theorem - Inversion - Periodic functions - Evaluation of integrals by Laplace transform - Solution of boundary value problems

Unit 2: PARTIAL DIFFERENTIAL EQUATIONS 9 Hours

Formation of PDE - Solution of std types of first order PDE - Lagrange's linear equation - Linear PDE of second and higher order with constant coefficients

Unit 3: FOURIER SERIES 9 Hours

Dirichlet‟s conditions - General Fourier series - odd and even functions - Half range sine and cosine series - complex form of Fourier series - Parseval‟s identity - Harmonic analysis

Unit 4: Z – TRANSFORM 9 Hours

Z-transform - elementary properties - Inverse Z-transform - Convolution theorem - formation of difference equation - Solution of difference equation using Z-transform.

Unit 5: FOURIER TRANSFORM 9 Hours

Fourier Integral formula - Fourier Transform - Fourier sine and cosine transforms - Linearity, Scaling, frequency shifting and time shifting properties - Self reciprocity of Fourier Transform - Convolution theorem - Application to boundary value problems

Text Books

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edition., 2001
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1st Edn., Reprint 2000, 1999

Reference Books

1. Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint 2004, 2003
2. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998
3. Venkataraman, M. K., Engineering Mathematics - III B, The National Publishing Company, Chennai, 13th Edition., Reprint 1999, 1998

MAT251	BIOSTATISTICS			L	T	P	C
				3	0	0	3
Pre-Requisite : NIL	Course Category :	Basic sciences and mathematics					
	Course Type :	Theory					

Course Outcome(s):

CO1: Explain, Calculate and interpret descriptive statistics including scales of measurement, Frequency distribution, Measures of central tendency, Measures of dispersion, Standard scores and the normal curve.

CO2: Read, Construct and analyze charts, graphs and contingency tables

CO3: Describe common parametric statistical test

CO4: Develop basic skills in critical review of the public health literature

CO5: Understand the basic concepts of probability, confidence intervals, and hypothesis test

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M					L					L		L		
CO2		M			M	H					L			M	M
CO3	H	H	L			H									
CO4	H	H			M	M									
CO5	L	M	L	M	M	H								M	L

Unit 1: INTRODUCTION **9 Hours**

Frequency distribution of data and the calculation of sample statistics. Measures of central tendency - measure of dispersion - Skewness and Kurtosis - Correlation and regression.

Unit 2: PROBABILITY **9 Hours**

Definition of probability - Laws of addition and multiplication of probabilities – parameter and statistics - population and sample - mean variable, standard deviation, standard error of mean and coefficient of variation.

Unit 3: FREQUENCY DISTRIBUTION **9 Hours**

Theoretical frequency distribution - student't' distribution - binomial, Poisson and normal distribution, Chisquare and F-distribution.

Unit 4: **9 Hours**

Test for single mean, mean difference, proportion, difference between proportion – small sample tests- based on t and F distribution - test for - single mean, difference between means - paired t test, testing the goodness of fit. ANOVA - one-way - two way classification.

Unit 5: **9 Hours**

Least square techniques for the estimation of constants in fitting curves - fitting by orthogonal polynomials - by iterative methods - testing the significance of the estimated constants.

TEXT BOOKS

1. John Bower, Statistical Methods for Food Science: Introductory procedures for the food practitioner, Wiley-Blackwell, 2ndedition, June 2009.
2. Rangasamy, R. A text book of Agricultural Statistics. New Age International Publishers, New Delhi, 2ndedition 2002

REFERENCE BOOKS

1. Richard, A. Johnson, Miller and Freund's Probability and Statistics for Engineers, Prentice hall of India Private Ltd., New Delhi, Eastern Economy Edition, 1994.
2. Kapoor, J.N. Saxsena, V.C. Mathematical statistics. S Chand & Co., 1997

CHY102	ENVIRONMENTAL SCIENCES				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Basic sciences and mathematics			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Know the importance of environmental studies and methods of conservation of natural resources.

CO2: Describe the structure and function of an ecosystem.

CO3: Explain the causes, effects and control measures of various types of pollutions.

CO4: Select the appropriate methods for waste management.

CO5: Get knowledge about various disaster management methods

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1							M								
CO2							M								
CO3							M						M		
CO4							M						M		
CO5							M								

Unit 1: NATURAL RESOURCES 9 Hours

Definitions – Scope of Environmental Sciences - Forest Resource – Food Resource – Land Resource – Water – Mineral resources - Utilization of Natural Resource, Impact on Environment – Conservation of Natural Resources.

Unit 2: ECOSYSTEM AND BIODIVERSITY 9 Hours

Concept – Structure and Function – Energy Flow in Ecosystem – Ecological Succession – Food Chain – Food Web, Ecological Pyramids – Biodiversity, Definition, Values, Threats to Biodiversity, Conservation of Biodiversity.

Unit 3: ENVIRONMENTAL POLLUTION 9 Hours

Definition, Causes, Effects and Control Measures of Air, Water and Soil Pollution – Thermal and Nuclear Pollution.

Unit 4: MANAGEMENT OF ENVIRONMENTAL POLLUTION 9 Hours

Solid Waste Management – Treatment Methods adopted for Municipal Sewage and Industrial Effluent – Hazardous and Biomedical Waste Management.

Unit 5: TOOLS FOR ENVIRONMENTAL MANAGEMENT 9 Hours

Environment Impact Assessment – Precautionary and Polluter Pay Principle - Constitutional Provision – (Air, Water and Forest) - Waste Minimization Techniques, Cleaner Technology Options, Bioremediation.

Text Book

1. Dhameja, S.K., Environmental engineering and Management, S. K. Kataria & Sons, New Delhi, 1st Edition, 2004

Reference Books

1. Bharucha Erach, the Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 1st Edition, 2001.
2. Miller, T.G. Jr., Environmental Science, Wadsworth Publishing Co. USA, 2nd Edition, 2004
3. Trivedi, R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances
4. and Standards, Vol. I and II, Enviro Media., New Delhi, 2nd Edition, 2004
5. Masters, G. M., Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 2nd Edition, 1997
6. Henry, J. G., and Heike, G. W., Environmental Science & Engineering, Prentice Hall International Inc., New Jersey, 1st Edition, 2005

HUMANITIES AND SOCIAL SCIENCE

HSS101	ENGLISH FOR TECHNICAL COMMUNICATION I				L	T	P	C
					2	0	0	2
Pre-Requisite	:	NIL	**Course Category**	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Participate in Non-verbal communication
CO2: Enjoy Close reading—skimming and scanning
CO3: Frame simple sentences to express daily activities
CO4: Take notes when reading and listening lectures and media events
CO5: Frame Instructions, Recommendations and Short Speeches

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1										H					
CO2										H					
CO3										H					
CO4										H					
CO5										H					

Unit 1: FOCUS ON LANGUAGE **9 Hours**

Parts of speech - nominal compounds, noun phrases - relative pronoun - adjective - numerical, comparison and contrast, collocation and word combinations - verb - preposition and relative - conjunction- connectives, expressions of purpose and function, cause and effect - articles - adjectives - sentence pattern - tenses - voice - rewriting the sentences in impersonal/abbreviated passive grammatical structures - concord - sentence level verb noun agreement - gerund - rewriting infinitive into gerund - imperative - rewriting imperative into recommendation using should - word formation - varied grammatical function of the same word - affixes - prefix and suffix, number prefix, negative prefix - reported speech - editing strategies - conditional structures - real, unreal, no possibility, zero condition - writing formal definition - abbreviation and acronym - idioms and phrases - varieties of English - British versus American.

Unit 2: LISTENING SKILLS **9 Hours**

Comprehension practice - vocabulary development - familiarity to varied types of spoken English and accents - developing ability to understand audio and video media - aiming at overcoming barriers to listening - listening to documentaries, radio news broadcasts, TV news telecasts - active listening in discussions and to lectures - taking notes while listening - extracting information from listening.

Unit 3: SPEAKING SKILLS 9 Hours

Oral practice - role play - interplay - seminar - transcoding visual into oral - participating in short and longer conversation - voice record, replay, correction of intonation, pronunciation and flow of speech - phonemes - vowels, consonants, stress, rhythm, intonation - group discussion - participative learning - acquiring proficiency, fluency, accuracy in oral communication - speaking practice - developing confidence - extempore speech - learning professional/conversational etiquette.

Unit 4: READING SKILLS 9 Hours

Vocabulary extension - improving vocabulary - intensive reading - reading strategies - identifying topic sentence - guessing meaning from content - picking out specific information - professional reading - reading practice - predicting the content, critical and analytical reading - reading articles in English newspapers, sports magazines, encyclopedias - reading aloud, use of stress and intonation - reading and comprehending technical materials - cloze reading.

Unit 5: WRITING SKILLS 9 Hours

Discourse cohesion - improving writing skills, avoiding common grammatical errors in academic writing - extending the hints - writing shorter sentences - punctuation - dialogue writing - paragraph writing, problems and solutions, achieving coherence, transition words, sequence words - essays of descriptive and argumentative - writing instructions, use of imperatives - jumbled sentences into sequential paragraph using linguistic clues - report writing - technical reports, industry visit reports, events reports - writing recommendations - letter writing - formal and informal letters - job application and resume, permission for in- plant training, business correspondence letters, calling for quotation, placing order, lodging complaint, persuasive letters - assignment writing - mini-project - transcoding - transferring of information from text to pictorial/graphical representation and vice versa.

Text books:

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005

Reference books:

1. Daniel Jones, English Pronouncing Dictionary, Universal Book Stall, New Delhi, 17th Edition, 2000
2. Geoffrey Leech, Fan Svartvik, A Communicative Grammar of English, Pearson Education Asia, 1994
3. Hornby, AS, Oxford Advanced Learner‟s Dictionary of Current English, OUP, 7 th Edition, 2005
4. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005

HSS102	ENGLISH FOR TECHNICAL COMMUNICATION II				L	T	P	C
					2	0	0	2
Pre-Requisite	:	NIL	**Course Category**	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Identify the errors in sentence structures

CO2: Construct grammatically correct sentences

CO3: Framing conversations

CO4: Effectively construct utterances for a Dialogue

CO5: Prepare various components of official communication like Memos, Circulars, Notices and Agendas

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1										H					
CO2										H					
CO3										H					
CO4										H					
CO5										H					

Unit 1: GRAMMAR AND VOCABULARY 9 Hours

Grammar and Vocabulary - Introduction to grammatical models - Proper use of tenses, concord, voice, articles, punctuation, and modal auxiliaries.

Unit 2: RECEPTION SKILLS 9 Hours

Listening and Language Development - Improving listening skills - comprehension practice - Comprehend classroom lectures, simple technically oriented passages - Listening to news bulletins, pre-recorded talks, different speech styles, comprehending the essential meaning - Physical and psychological barriers to listening - Steps to overcome the barriers - Practice in note-taking while listening.

Unit 3: SPEAKING TECHNIQUES 9 Hours

Speaking practice - Improving conversing skills - Improving self-expression - Developing confidence and fluency in oral communication - Physical and psychological barriers to speaking - Steps to overcome the barriers - Formal and public speaking practice - Extemporary talk practice - Speech process - fluency and accuracy in speech - Developing persuasive speaking skills - Conversation in a given milieu, social and cultural surroundings - Practice in giving small talks on local topics for a minute or two - Goal oriented group discussion - Participating in seminars - Independent and effective communication

Unit 4: READING STRATEGIES 9 Hours

Reading comprehension - Vocabulary extension methods - Speed reading practice - technicalcand non-technical materials - Practice in various reading techniques - skimming, scanning, eye reading - Looking for specific information - Comprehending the given passages, technical information.

Unit 5: WRITTEN COMMUNICATION 9 Hours

Basic grammatical structures - Alphabet of other languages - Paragraph writing - Expressing the idea in writing - Avoiding and correcting common errors - Effective writing techniques - brevity, clarity, objectivity and simplicity - Discourse writing - definition, description, instruction - Note-making - Proof reading - Mechanics of writing - Writing formal, informal.

TEXT BOOKS

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005.
2. Rutherfoord Andrea J, Basic Communication Skills for Technology, Pearson Education, 2002.

REFERENCES

1. Deborah C Andrews, Margaret D Bickle, Technical Writing - Principles and Forms, Macmillan, 1978.
2. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005.
3. Sarah Freeman, Written Communication in English, Orient Longman, 2000.
4. Thomson A J & AV Martinet, A Practical English Grammar, OUP, 4th Edition, 1986.
5. Tom Hutchinson, Alan Waters, English for Specific Purpose, Cambridge University Press, 1987.

BASIC ENGINEERING

CSE102	PROGRAMMING LANGUAGES				L	T	P	C
					2	0	0	2
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Theory			

Course Outcome(s)

CO1: To learn the basics of computer programming concepts using C programming language.
CO2: To design programs involving decision structures, and loops
CO3: To understand how to include functions and structure as part of the solution
CO4: To utilize pointers & arrays to efficiently solve problems and understand the dynamics of memory
CO5: To understand the file system and operations on files

Mapping of COs and Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M													
CO2		H	H	M										L	
CO3		M	H												
CO4		M	H	M										L	
CO5		M													

Unit 1: BASIC ELEMENTS OF C & CONTROL STATEMENTS 9 Hours

Introduction to C programming – C character set – Identifiers, keywords, data types, constants, variable, declarations, expressions, statements, symbolic constants, Operators and Expressions- Operator precedence and associativity of operators -Input and Output Functions-Library Functions - Header Files - Simple Computational problems. Decision Making: if statement - if-else statement - else-if ladder – Looping statements - While – do-while- Still more looping-For statement, Nested control statements- switch statement – the break statement - ? : Operator - Continue statement - goto statement – Problems using Control Structures.

Unit 2: USER DEFINED FUNCTION FUNCTIONS & STORAGE CLASSES 9 Hours

Need for User defined functions, a multifunction program- Elements of user defined functions- Definition of Functions- Return values and their Types- Function Calls-Function declaration- Category of functions- Nesting of functions – Recursion- Problems on functions & recursion functions. Storage Classes -Automatic Variables - External Variables – Static and Register Variables.

Unit 3: ARRAYS AND POINTERS 9 Hours

Defining and Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Enumerated data types-Programs using sorting, searching and merging of arrays. Pointer Fundaments - Pointer Declarations - Passing Pointers to Functions - Arrays and Pointers - Pointers and One-Dimensional Arrays - Pointers and Multidimensional Arrays - Operations on Pointers-Programs using Pointers with Functions

Unit 4: DYNAMIC MEMORY MANAGEMENT, STRUCTURES & UNIONS 9 Hours

Dynamic Memory Allocation – Allocating a Block of memory, multiple blocks, releasing used space, altering the size of block. – Defining a Structure - Processing a Structure – User defined Data Types – Nested structure - Structures and Pointers - Passing Structures to Functions - Self Referential Structures- Arrays and & Structures Union

Unit 5: DATA FILES AND UNIX OS 9 Hours

Opening and Closing a Data File - Creating a Data File – Reading & writing a data file. Processing and Updating of Data Files - Unformatted Data Files - Programs using merging, searching of data file contents. Introduction to Operating System. Shell fundamentals- shell commands – File commands- Directory commands-Miscellaneous commands

Text books:

1. Byron S. Gottfried, Programming with C, Second Edition, Tata McGraw Hill, 2006

Reference books:

1. Brian W. Kerninghan and Dennis M.Richie, “The C Programming language”, Pearson Education, 2005.
2. Johnsonbaugh R.and Kalin M, “Applications Programming in ANSI C”, Third Edition, Pearson Education, 2003.
3. E. Balagurusamy “Programming in ANSI C” fourth edition TMH 2008
4. V.Rajaraman “Computer Basics and C Programming” PHI 2008
5. Stephen Kochan and Patrick Wood, UNIX Shell Programming, Third Edition, Pearson education, 2003

CSE181	PROGRAMMING LANGUAGE LABORATORY	L	T	P	C
		0	0	3	1

Course Outcomes:

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

CO1: Understand problem analysis, algorithm design, and program implementation

CO2: Write modular, efficient and readable C programs

CO3: Design modular programs with structured programming constructs

CO4: Ability to formulate problems and implement algorithms in C and work in a team to develop projects

CO5: Understand the basic commands of UNIX and write shell programming

Course Outcomes Vs Program Outcomes Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		H	H	M											
CO2	M														
CO3	M	M	H												
CO4	M	H	H	H					H	M	M	L		L	
CO5	M														

List of Experiments:

APPLICATION PACKAGES

1. Word Processing
2. Spreadsheet
3. Powerpoint
4. Database Management

C PROGRAMMING

1. Basics
2. Operators and Expressions
3. I/O formatting
4. Control Statements

ARRAYS AND FUNCTIONS

1. Arrays
2. String Manipulation
3. Functions

POINTERS, STRUCTURES AND FILES

1. Pointers
2. Structures and Unions
3. File Handling

UNIX PROGRAMMING

1. Basic Unix Commands
2. Basic Shell Programming

EEE101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING				L	T	P	C
					4	0	0	4
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Interpret the basic electrical and electronics circuits.

CO2: Understand the DC and AC single phase and three phase fundamentals.

CO3: Understand the working principle of various Electrical AC and DC machines.

CO4: Get the knowledge about various Analog type measuring instruments and house wiring.

CO5: Get the knowledge about basic semiconductor devices.

Mapping of COs and Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2	M												L		
CO3	M												L		
CO4		M													
CO5		M													

Unit 1: MAGNETIC CIRCUITS **9 Hours**

Magnetic circuits - definition of MMF, flux and reluctance - reluctance in series and parallel - electromagnetic induction - Fleming‟s rule - Lenz‟s Law - Faraday‟s laws - statically and dynamically induced EMF - self and mutual inductance - coefficient of coupling - hysteresis - eddy currents - analogy of electric and magnetic circuits - simple problems.

Unit 2: DC CIRCUITS AND AC CIRCUITS **9 Hours**

Electrical quantities - resistors - inductors - capacitors - Ohm‟s Law - Kirchoff‟s Laws - series and parallel circuits - analysis of DC circuits - mesh, nodal - simple problems.

Sinusoidal functions - phasor representation - RMS Effective values - form and peak factors - RLC circuits - power and power factor - analysis of 3 phase AC circuits - simple problems.

Unit 3: ELECTRICAL MACHINES **9 Hours**

Construction and principle of operation of DC machines - generator, motor - single phase transformers - alternators - three phase and single phase induction motors.

Unit 4: ELECTRONIC DEVICES **9 Hours**

Basic concepts of PN junction diodes - zener diode - bipolar junction transistor - uni polar devices - FET, MOSFET, UJT - thyristor - photoelectric devices.

Unit 5: ELECTRONIC CIRCUITS **9 Hours**

Half wave and full wave rectifier - amplifier - oscillator - RC integrator and differentiator circuits - diode clampers and clippers - multivibrators - schmitt trigger.

Text books:

1. V.K. Mehta, “Principles of Electrical Engineering and Electronics”, S. Chand & Company Ltd, 2008.
2. Kothari D P and Nagrath I J, "Basic Electrical Engineering", Tata McGraw Hill, 1991.
3. Mithal G K, Electronic Devices & Circuits, Khanna Publications, 1997

Reference books:

1. T. Thyagarajan, “Fundamentals of Electrical and Electronics engineering”, SciTech publications (Ind.) Pvt. Ltd., 3rd Edition, October 2000.
2. Muraleedharan K.A, Muthususbramanian R and Salivahanan S, "Basic Electrical, Electronics and Computer Engineering" Tata McGraw Hill, 1999.

MEC101	ENGINEERING DRAWING				L	T	P	C
					1	0	3	2
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Explain the basic principle of engineering drawing to read and create an engineering drawing using standard views and convert pictorial (H-D) drawing to orthographic (M-D) drawing

CO2: Demonstrate the principle of projection in all the four quadrant and apply the knowledge in projection of points, in particular first angle projection for straight lines and planes

CO3: Illustrate the principle and application of solids and its sectioning.

CO4: Employ the basic concepts of development of surfaces for all types of solids

CO5: Use the basic knowledge in isometric projection and convert into pictorial drawings.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		M												
CO2		H		L											
CO3	M		H	L											
CO4	L	M		L											
CO5	H		H	M											

Unit 1: INTRODUCTION 9 Hours

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - orthographic principles – missing view - free hand sketching in first angle projection from pictorial views.

Unit 2: PROJECTION OF POINTS, STRAIGHT LINES AND PLANES 9 Hours

Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations, location of traces – projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes.

Unit 3: PROJECTION OF SOLIDS AND SECTION OF SOLIDS 9 Hours

Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method – types of section – full section and half section -conventional section lines - section of simple solids like prisms, pyramids, cylinder and cone in vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section

Unit 4: DEVELOPMENT OF SURFACES 9 Hours

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones - development of lateral surfaces of combined solids.

Unit 5: ISOMETRIC AND PERSPECTIVE PROJECTION 9 Hours

Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones - Orthographic to isometric view – Introduction to perspective projection.

Text books:

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, Tata McGraw-Hill publishing company, New Delhi , 2008

Reference books:

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
2. Nataraajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.
3. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 46th Edition, 2003.
4. Luzadder and Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt Ltd, New Delhi, XI Edition, 2001.
5. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2002.

CIV101	BASIC CIVIL AND MECHANICAL ENGINEERING				L	T	P	C
					4	0	0	4
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Describe the scientific terminologies related to construction and mechanical sciences.
CO2: Understand the basic laws pertaining towards the mechanical and civil sciences
CO3: Understand the procedures for construction of several structures.
CO4: Knowledge in surveying, their types and the equipments used.
CO5: Explain the principle, working and application of Engines and Power plants.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2	M														
CO3													L		
CO4	M														
CO5	M														

Unit 1: BUILDINGS 9 Hours

Characteristics of good building materials such as stones, bricks, plywood and ceramic tiles, timber, cement, aggregates and concrete - Basic functions of buildings – Major components of buildings – Foundations - Purpose of a foundation – Bearing capacity of soils – types of foundations. Proper methods of construction of Brick masonry – Stone masonry – Hollow Block masonry. Beams – Lintels – Columns – Flooring – Damp proof course – surface finishes – Doors and windows – Roofing.

Unit 2: TRANSPORTATION ENGINEERING 9 Hours

Principles and Classification of surveying, Chain surveying, Compass surveying and leveling - Importance of roads – Classification of Highways – water bound macadam, bituminous and cement concrete roads – . Railways - Importance of railways – Gauges – Components of a permanent way. Bridges - Components of Culverts – Causeways, Slab Bridge, T-beam and slab bridge, Suspension bridge

Unit 3: MECHANICAL ENGINEERING BOILERS AND TURBINES 9 Hours

Boilers - boiler mountings and accessories – Cochran boiler, Locomotive boiler, Babcock and Wilcox boiler, fire and water tube boilers - Steam turbine - single stage impulse turbine, Parson‟s reaction turbine, difference between impulse and reaction turbines.

Unit 4: POWER PLANTS AND INTERNAL COMBUSTION (IC) ENGINE 9 Hours

Classification of power plants – steam, nuclear, diesel and hydro power plants - Alternate sources of energy - solar, wind, tidal, geothermal, ocean thermal energy conversion. – IC engine - components, working of four and two stroke petrol and diesel engines.

Unit 5: PRODUCTION TECHNOLOGY 9 Hours

Metal casting and forming process – patterns, moulding, melting of cast iron, casting – forging – rolling – extrusion – drawing - Metal joining process - welding – arc welding, gas welding, brazing and soldering - Metal machining – lathe, drilling machine, milling machine, shaping machine, planing machine, introduction to Computer Numerical Control machining.

Text books:

1. Shanmugam, G,, and Palanichamy, M.S., Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.

Reference books:

1. Khanna, K., Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2001
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, New Delhi, 1997.
3. Venugopal K., Basic Mechanical Engineering, Anuradha Publications,
4. Kumbakonam, 2000, Shanmugam G., Basic Mechanical Engineering, Tata McGraw Hill Publishing Co.,New Delhi, 2001.

MEC181	LABORATORY WORK SHOP				L	T	P	C
					0	0	3	1
Pre-Requisite	:	NIL	Course Category	:	Basic Engineering			
			Course Type	:	Theory			

Course Outcome(s):

CO1: Develop simple wooden joints using wood working tools..
CO2: Demonstrate and fabricate metal joining with simple sawing process
CO3: Recognize the development of sheet metal models with an understanding of their application
CO4: Practice various machining techniques like drilling, tapping, etc..
CO5: Describe the basis of welding, foundry, smithy and plumbing works.

Mapping of Cos and Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M			M					L						
CO2	M				L										
CO3	M								L						
CO4															
CO5					L								L		

Unit 1: CARPENTRY **9 Hours**

Carpentry tools - practice in marking, sawing, planning and chiseling – making simple joints: lap joint, T-joint, dovetail joint, mortise and tenon joint.

Unit 2: FITTING **9 Hours**

Fitting tools - practice in marking, filing, punching, hack sawing - fitting to size and drilling - making of simple mating profiles: V, square, dovetail, half round joints.

Unit 3: SHEET METAL **9 Hours**

Study of press, die and tools - sheet metal layout - development of lateral surfaces -simple exercises: blanking, forming, bending and flanging.

Unit 4: DRILLING **9 Hours**

Drilling and tapping in drilling machines Demonstration on:

i. Welding operations like butt joint and lap joints in Arc welding
ii. Foundry operations like mould preparation for split pattern
iii. Smithy operations like the production of hexagonal bolt
iv. Preparation of plumbing line sketches – basic pipe connections involving the fittings like valves, taps, couplings, unions, reducers, elbows and other components used in household fittings.

CORE COURSES

FBT101	BIOCHEMISTRY OF FOOD				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Program Core			
			Course Type	**:**	Theory			

Course Outcome(s):

CO1: Describe the food groups, water activity and its importance

CO2: Explain the properties of carbohydrate and protein present in food materials

CO3: Summarize the properties and nutritional value of lipids in food components.

CO4: Discuss the importance, source and effects of mineral and vitamins.

CO5: Classify food pigment, enzymes and their application in food processing

Mapping of Cos and Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M						H					H	H	L	
CO2	H	L					L					M	M	L	
CO3	H		L									M	H		
CO4	H	M	L									L	M		
CO5	H	H	M				M					M	H	L	

Unit 1: INTRODUCTION **9 Hours**

Importance of food, Scope of food chemistry - Introduction to different food groups: their classification and importance -Water -Structure of water molecule, types and properties of water, water activity and its importance

Unit 2: CARBOHYDRATES **9 Hours**

Carbohydrates -Definition, classification, sources, chemical make-up, properties, nutritional and industrial importance- Proteins - Sources, chemical make-up, properties, nutritional aspects– amino acids, amino essential acids, biological value, PER (Protein Efficiency Ratio), and industrial importance

Unit 3: LIPIDS **9 Hours**

Fats -Sources, chemical make-up, properties, nutritional aspects – essential fatty acids, PUFA (Polyunsaturated Fatty Acids) hydrogenation, rancidity and industrial- importance - Deficiency disorders and requirement of different nutrients

Unit 4: MINERALS & VITAMINS **9 Hours**

Minerals and Vitamins -Importance and sources of minerals and vitamins with special emphasis on calcium, iodine, zinc, iron, fluoride, fat, and minerals soluble and water- soluble vitamins, effect of processing and storage on vitamins- Deficiency disorders and requirement of different vitamins

Unit 5: FOOD PIGMENTS AND ENZYMES 9 Hours

Food Pigments-Importance, types and sources of pigments - their changes during processing and storage- Enzymes -Definition, importance, sources, nomenclature, classification – discuss their application in food processing in brief.

Text books:

1. William Harold Peterson, John Taylor Skinner, Frank Morgan Strong, Elements of Food BioChemistry, Prentice-hall., The Univesity of Michigan., 2009.
2. Joseph Braverman B., S., Introduction to the biochemistry of foods, Elsevier Pub.Co., 1963.

Reference books:

1. Keith Ellis, Linden, G., Food Biochemistry, Chapman & Hall, 1991.
2. Fatih Yildiz, Ted Labuza, Mohamed Besri, Applied Food BioChemistry, CRC Press,Taylor & Francis Group.
3. Framroz Pirojshaw Antia,Clinical dietetics and nutrition, second edition ,Oxford U.P.,1967.
4. Shubhangini A., Joshi, Nutrition and Dietetics, Tata McGaw-Hill Publisher,1992.

FBT201	FOOD MICROBIOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objectives:

Recognize and describe the characteristics of important pathogens and spoilage microorganisms in food.

Course Outcome(s):

CO1: Recall the historical developments in microbiology & classify the different microorganisms.

CO2: Identify the routes of food contamination and biochemical changes caused by microorganisms.

CO3: Interpret the significance of microbial spoilage in different foods.

CO4: Relate the various food borne diseases and its causes

CO5: Select the appropriate techniques to prevent food spoilage.

Mapping of COs and Pos

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H							M				L	M		
CO2		H	M			M	M					M	M		
CO3	M	M	M			M	M					M	H	M	M
CO4	M	M	M	M		L						M	M	H	
CO5	M	M	H			H	H					M	H	H	M

Unit 1: INTRODUCTION **9 Hours**

Introduction – Definition, historical developments in the food microbiology and its significance- Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms - Study of microorganisms including bacteria, virus, yeast and mold- Morphology, structure, classification and methods of measurement of growth.

Unit 2: FOOD CONTAMINANTS **9 Hours**

Contaminants of foods-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing- Biochemical changes caused by micro-organisms, deterioration of various types of food product.

Unit 3: FOOD SPOILAGE **9 Hours**

Spoilage of foods and causative agents- Factors affecting spoilage- Microbiology of milk and milk products- Microbiology of meat, fish, poultry and egg products -Microbiology of fruits and vegetable products - Microbiology of cereal and cereal products.

Unit 4: FOOD BORNE DISEASES AND FOOD FERMENTATION 9 Hours

Factors affecting growth of microorganism in food, intrinsic and extrinsic factors- food borne pathogens, food poisoning, food infection and intoxication. Microbial food fermentation, standards for different foods

Unit 5: FOOD SPOILAGE CONTROL 9 Hours

Control of microbial growth and spoilage (Staphylococcus, Bacillus, Listeria, Salmonella) - Anti-microbial agents – physical and chemical agents – their mechanism of action – Mutation

Text books:

1. James M. Jay, Martin J Loessner and David A. Golden, Modern Food Microbiology, Springer, seventh edition, 2005.
2. Thomas J. Montville, Karl R. Matthews,Food Microbiology: an Introduction, ASM Press, 2nd Edition, May 2008.

Reference books:

1. King R.D. and P.S.J. Cheetham, Food Biotechnology Elsevier Applied Science, New York, 1986.
2. Frazier, W.C. and Westhoff, Modern Food Microbiology, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 4th edition, 1992.
3. Jay, J.M.. Modern Food Microbiology. CBS Publishers & Distributors, New Delhi, 4th edition,1996.

CHE254	PRINCIPLES OF CHEMICAL ENGINEERING				L	T	P	C
					3	1	0	4
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory with tutorial			

Course Objectives:

To acquaint them with the fundamentals of the application of material and energy balances in chemical engineering.

Course Outcome(s):

CO1: Select the appropriate flow measurement devices to measure the properties of different types of fluids

CO2: Classify the different types of liquid filters and its application.

CO3: Illustrate the thermal properties of foods and outline the different modes of heat transfer on thermal death kinetics.

CO4: Relate the electric power utilization and thermodynamic phase change for steam generation.

CO5: Summarize the refrigerant and chilling system to calculate heat load.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		M								M			
CO2	M	M	L	M		M	L					M	M	L	
CO3	H	M	M	M	M	M		M	M			M	H	H	M
CO4	H	M	M	M	H	M						M			
CO5	H	M	L		H	M	M					H	H	M	M

Unit I: 9 Hours

Properties of liquids: Density, Viscosity and stress in fluid flow, Measurement of Viscosity: Capillary tube viscometer, Rotational viscometer, influence of temperature on viscosity, Properties of non-Newtonian liquids, Handling systems for Newtonian liquids: Flow characteristics, Reynolds number, Laminar flow and turbulent flow. Mechanical Energy Balance: as a function of Potential and Kinetic Energy, pressure and frictional forces, Pump Selection and Performance: Characteristic Diagrams of pumps, Net Positive suction head, computation of pump requirements, Flow Measurement: Pitot tube, Orifice meter, Venturi meter, paddle flow meters, magnetic flow meters.

Unit 2: FILTRATION 9 Hours

Introduction to liquid filtration, filter media, classification of liquid filtration, formation of filter cake, Darcy Equation, Constant rate/ Constant pressure, filtration, typical wine filtration conditions using dead-end filters, cross-flow filters, plate & frame filters, cartridge filters, membrane filters, Ultra filtration/microfiltration, Sizing of filtration equipment.

Unit 3: SYSTEMS FOR HEATING AND COOLING OF LIQUIDS: 9 Hours

Plate heat exchanger, Tubular heat exchanger, Thermal properties of foods; Specific heat, Thermal conductivity, Conductive heat transfer, convective heat transfer, Thermal processing: Decimal Reduction time (D), Thermal resistance constant, thermal death time (F), Relationship between chemical Kinetics and Thermal Processing Parameters: Decimal reduction time, rate constants k and Q10 Thermal resistance constant z, Activation energy Ea and their inter-relationship.

UNIT 4: 9 Hours

Steam generation: Steam generation systems, Thermodynamics of phase change, steam tables, Steam utilization, Electric Power utilization: Electrical terms and units, Ohms law, Electric circuits, electric motors, electrical controls.

UNIT 5: 9 Hours

Selection of Refrigerants, components of refrigeration system (Evaporator, Compressor, Condenser and expansion valve), Basic design of chilling systems, and calculation of heat load.

Text books:

1. McCabe, W.L., Smith, J.C., Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill, New York, 7th ed, 2005.
2. Brennan, J. G., Butters, J. R., Cowell, N. D. and Lilly, A. E. Food Engineering Operations, Applied Science, London, 3rd Edition, 1990.

References:

1. Coulson, J.M., Richardson, J.F, Backhurst J.R. and Harker J.M., Coulson and Richardson‟s Chemical Engineering, Volume I, Butter worth Heinemann, Oxford, New York, 5th Edition, 2002
2. David, M. Himmelblau, Basic Principles and Calculations inChemical Engineering, Prentice-Hall of India, New Delhi,7th Edition, 2004
3. Fellows, P. Food Processing Technology, Principles and Practice, Woodhead, Cambridge, 2nd Edition, 2000

FBT202	PRINCIPLES OF FOOD PROCESSING & PRESERVATION				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

To Introduce students about the methods of preserving food to prevent wastage and losses.

Course Outcome(s):

CO1: Indicate the needs for preservation and mechanisms of preservation
CO2: State the principles involved in extension of storage life of foods at low temperatures;
CO3: Select the appropriate thermal processing parameters to preserve the food.
CO4: Recall the basic concepts of concentration and dehydration methods to extend the shelf life of foods.
CO5: Recommend the suitable methods to preserve foods

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L														
CO2	H		M			M	M	L				M	H		
CO3	H	M	M		L	H	H	L				H	H	H	H
CO4	H		M			M	M	L					H		
CO5		M	H			H	H	M				H	M	H	H

Unit 1: INTRODUCTION **9 Hours**

Scope and importance of food processing- Properties of food- Physical, thermal, mechanical, sensory. Characteristics of tissues and non-tissues foods, Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods, intermediate moisture foods, wastage of foods.

Unit 2: PRESERVATION **9 Hours**

A. Chilling temperatures: Consideration relating to storage of foods at chilling temperatures, Applications and procedures, Controlled and Modified atmosphere storage of foods, Post storage handling of foods.
B. Freezing temperatures: Freezing process, Slow and fast freezing of foods and its consequence, other occurrences associated with freezing of foods. Technological aspects of pre freezing, Actual freezing, frozen storage and thawing of foods.

Unit 3: **9 Hours**

Basic concepts in thermal destruction of microorganisms D, Z, F values, Heat resistance and thermophilic microorganisms. Cooking, Blanching, Pasteurization and Sterilization of foods. Assessing adequacy of thermal processing of foods, General process of caning of foods, Spoilage in canned foods.

Unit 4: **9 Hours**

Principles, Technological aspects and application of evaporative concentration process; Freeze concentration and membrane process for food concentrations. Principles, Technological aspects and application of drying and dehydration of foods, Cabinet, tunnel, belt, bin, drum, spray, vacuum, foam mat, fluidized-bed and freeze drying of foods.

Unit 5: **9 Hours**

Principles, Technological aspects and application of sugar and salt, Antimicrobial agents, Biological agents, non- ionizing and ionizing radiations in preservation of foods.

Text books:

1. V.Kyzlink Principle of Food Preservation, Elsevier Amsterdam, Oxford, New York, Tokyo, 1990.
2. Toledo, R.T., Fundamentals of Food Process Engineering, 2nd Edition, van Nostrand, Reinhold, New York, 1991

Reference books:

1. James M. Jay, Martin J Loessner and David A. Golden, Modern Food Microbiology Seventh edition, Springer, 2005,
2. Singh, R. P. and Heldman, D. R., Introduction to Food Engineering, 3rd. Edition, Academic, London, 2001.

FBT203	DAIRYING AND DAIRY PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Program Core			
			Course Type	**:**	Theory			

Course Objective(s):

- To enable the students to understand the need and importance of dairy
- To know the compositional and technological aspects of milk

Course Outcome(s):

CO1: Describe the composition, quality and nutritional value of milk and milk products.
CO2: Inspect the quality of milk using its physico chemical properties
CO3: Select the suitable techniques to process the milk and sanitisation methods.
CO4: Outline the process flow for various dairy products
CO5: Summarize the various methos of manufacturing milk products and milk industry cleaning and sanitation practices.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M										M	M		
CO2		M	M	M	M	H	M	M				M	H	H	
CO3	M	M	L		M	M	M	M				M	L	H	H
CO4		M	M			M	M	M				M	H	M	H
CO5	M	L	M		M	M	M	M				H	H	M	H

Unit 1: INTRODUCTION 9 Hours

Sources, and composition of milk, Status of Dairy Industry in India. Cooperative Dairying. Operation Floods. Chemical composition, microbiological quality, and nutritional importance of milk and milk product in PFA Act, Rules, 1955 as amended to date.

Unit 2: FLUID MILK 9 Hours

Physicochemical characteristics and factors affecting them. Production, collection, testing quality, cooling, storage, and transportation of liquid milks. Receiving and quality assessing of liquid milk in dairy industry for detection of adulteration, decision for acceptance/rejection, and determination of price of the milk.

Unit 3: MILK PROCESSING TECHNOLOGY 9 Hours

Standardization and/or processing (pasteurization, sterilization and UHT processing), storage, packaging and distribution of liquid milks: whole, standardized, toned, double-toned, and skim milk. Recombined, reconstituted, and flavored milks. Cleaning and sanitization of dairy equipments and plant as a whole.

Unit 4: MILK PRODUCTS 9 Hours

Definition, composition, methods of preparation/production, quality and/or grading parameters, packaging, storage characteristics, uses and shelf-life of cream, butter and ghee; evaporated and condensed milks, skimmed, whole and instants milk powders.

Unit 5: MANUFACTURE OF DAIRY PRODUCTS 9 Hours

Butter manufacture -methods-cheese manufacture-methods. Ice - cream manufacture-over-run-types of freezers-Drum dryer-spray dryer-construction, powder recovery systems-agglomeration. stantization of milk and milk products. Judging and grading of milk and its products. In-plant cleaning system.

Text books:

1. Sukumar De, Outlines of Dairy Technology, Oxford University Press, 2nd edition, 1994.
2. James N. Warner, Principles of Dairy Processing, Wiley Eastern Ltd, 3rd edition 1998.

Reference books:

1. Milk and Milk Products by Eckles,Combs; and Macy,Tata McGraw Hill.
2. Robinson, R.K. Modern Dairy Technology Elsevier Applied Science, UK2 vol, 1986.

FBT204	FOOD ADDITIVES				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

To enable the students to understand types and chemical properties of preservative, emulsifiers and antioxidants

Course Outcome(s):

CO1: Describe the basic food additives used in food industry.
CO2: Identify emulsifier, stabilizer and bleaching agent used in food industry
CO3: Classify the types of preservatives and additive used in food application
CO4: Outline food colors, flavor, related substances and its legal standards
CO5: Explain different laws and quality standards for food additives

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		L									L	M	L	
CO2	M	M	H	L		M	L	M				M	H	M	L
CO3	H	M	H		`	M	L	M				M	H	M	M
CO4	H	M	H	L		H	L	M	L	L		M	H	H	L
CO5	M	H	H			H	H	H	L	L		M	H	M	

Unit 1: INTRODUCTION **9 Hours**

Definitions, uses and functions of Acid, Base, Buffer systems, Salts and chelating/sequestering agents, Masticatory substances. Low calorie and non-nutritive sweeteners, Polyols.

Unit 2: **9 Hours**

Antioxidants, Emulsifying and stabilizing agents, Anti-caking agents, thickeners, Firming agents. Flour bleaching agents and Bread improvers. Mould Inhibitors - Emulsifiers

Unit 3: **9 Hours**

Anti microbial agents / Class I and Class II preservatives as per PFA Act. Anti-caking agents - Flour maturing and bleaching agents, Texture modifiers, stabilizers, thickeners, Humectants, Leavening agents

Unit 4: **9 Hours**

Colorants, Flavoring agents and related substances, clarifying agents. Gases and Propellants. Tracers and other additives. Low and non-calorie sweetening agents, Fat replacers, Stability of food additives during processing, Legal standards and permissible limits of food additives.

Unit 5: 9 Hours

Compulsory and voluntary trade and Company standards. Consumer Protection Act (1986) and relevant Food Legislation (Act, orders, standards): PFA(1954), FPI(1955), SWMA, MPO(1977), VCO(1978), AgMark, BIS, US, Canadian, EU, ISO and Codex Food Standards, Export Quality Control and Inspection act (1963), Environment Protection Act (1986), WTO & GATT.

Text books:

1. Evaluation of certain food additives and contaminants: fifty-seventh report of the Joint FAO/WHO Expert Committee on Food Additives 2002., Geneva., vol 909
2. Food additives: competitive, regulatory, and safety problems United States. Congress. Senate. Select Committee on Small Business. 1977, Volume 1., U.S. Govt. Print. Off., 1977
3. Food Additives: A Shopper's Guide to What's Safe & What's Not Christine Hoza Farlow, Edition-4., Kiss for Health Pubns, 2001

Reference books:

1. Noel Rees Jones, Dorothy W. Flowerdew, Food additives: descriptions, functions and U.K. Legislation., British Food Manufacturing Industries Research Association., Edition-3., British Food Manufacturing Industries Research Association, 1982.

FBT281	FOOD BIOCHEMISTRY LABORATORY				L	T	P	C
					0	0	3	2
Pre-Requisite	:	FBT101	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

- To explain how water, carbohydrate, lipids, proteins, vitamins and minerals react in foods
- To explain the biochemical and functional properties of food additives and enzymes during processing and storage

Course Outcome(s):

CO1: Estimate simple sugars, starch and fibres in food samples
CO2: Examine the amount of minor nutrients in food.
CO3: Analyze the saponification and iodine value of sample
CO4: Demonstrate the browning reactions in different food samples
CO5: Estimate the preservatives and antioxidants in different foods

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		L		L	L		H	M		M	H	M	L
CO2	H	H	L	L		M	L	L	H	M		M	H	M	L
CO3	M	M	L	L		M			H	H	L	L	H	M	L
CO4	M	H	L	L		L		L	H	H	L	L	H	M	L
CO5	M	H	L	L		H	M	M	H	M		L	H	H	L

List of experiments:

1. Determinations of proteins, starches, sugars, amino acids,
2. Determinations of crude fiber, total minerals, crude fat and water in foods.
3. Determination of minerals-calcium, phosphorus, iron,
4. Estimation of vitamins-ascorbic acid, carotene, thiamine.
5. Browning reaction in food,
6. Analysis of lipids-saponification value, acid value and iodine value,
7. Determination of tannins, chemical residues and aflatoxins
8. Estimation of preservative and antioxidants.

FBT282	FOOD MICROBIOLOGY LABORATORY			L	T	P	C
				0	0	3	2
Pre-Requisite	:	NIL	Course Category :	Program Core			
			Course Type :	Practical			

Course Objective(s):

Recognize and describe the characteristics of important pathogens and spoilage microorganisms in food

Course Outcome(s):

CO1: Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures

CO2: Perform routine culture handling tasks safely and effectively

CO3: Prepare different types of media and plating techniques to grow the microorganisms

CO4: Isolate and identify the microorganisms found in specific food products.

CO5: "Identify various culture media and their applications and also understand various physical and chemical means of sterilization"

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M			M	M			M		M	M	M	
CO2	H	M	M			M	M		M	M		M	M	M	
CO3	H	H	H			M	M		M	M		H	M	M	
CO4	H	H	H			M	M		M	M		H	H	H	
CO5	M	M							M	M		M	M		

List of experiments:

1. Sterilization techniques and equipments
2. Preparation of culture media
3. Isolation of microorganisms and Enumeration
4. Simple staining
5. Gram staining
6. Enumeration of coliforms
7. Purification of bacteria and fungi
8. Dye reduction test
9. Measurement of microorganisms
10. Study and experiments with different microscope
11. Storing Techniques
12. Spore Staining

FBT283	FOOD PRESERVATION AND PROCESSING LABORATORY -I				L	T	P	C
					0	0	3	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

To Introduce students about the methods of preserving food to prevent wastage and losses

Course Outcome(s):

CO1: Demonstrate low and high temperature food preservation methods
CO2: Carry-out different food preservation techniques to process foods.
CO3: Develop value added products from fruits and vegetables.
CO4: Develop ready to serve foods (RTS) products.
CO5: Choose the specific ingredients for development of speciality foods.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M	L		M		M	H	L			H	L	M
CO2	H	M	M	L		M		M	H	L		L	H	L	M
CO3		M	H	M		M		M	H	H	L	L	H	M	M
CO4		M	H	M		M		M	H	H	L	L	H	M	M
CO5		M	H	M		H		M	H	H	L	L	H	M	M

List of experiments:

1. Extension of shelf life/ preservation of foods by use of low temperature.
2. Processing and preservation of Peas by use of high temperature.
3. Preservation and processing of certain vegetables by drying and dehydration (Water removal)
4. Osmotic concentration/dehydration of certain fruits and vegetables using concentrated sugar and salts solutions (reduction in water activity)
5. Preparation of Jam/Jelly and its preservation by sugar.
6. Preparation of tomato puree/ketchup and its preservation by chemical preservatives.
7. Preparation of fruit juice/pulp and its preservation by chemical preservatives/ thermal processing.
8. Preparation of cordials and squash as per FPO specification.
9. Preparation of pickles/ sauerkraut.
10. Preparation of sugar boiled candy.
11. Preparation of low sodium foods
12. Preparation of malt-based drink
13. Preparation of foods for under-weight persons
14. Preparation of high caloric diet for sportsmen
15. Preparation of high protein diet for sportsmen
16. Preparation of fortified atta

CHE255	UNIT OPERATIONS IN FOOD PROCESSING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	CHE253	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

This course aims at making the students understand the fundamental principles and concepts of heat transfer and mechanical operation in biochemical processes.

Course Outcome(s):

CO1: Explain the basis of dimensional consistency and principle involved in unit operation system.

CO2: Describe the Crystallisation and distillation techniques in separating and purifiying the organic compounds.

CO3: Illustrate the construction and operational principles of filtration and sedimentation in food processing.

CO4: State the principles of agitation & mixing in desiging food prcoess.

CO5: Interpret the basic principle of psychrometric chart and air conditioning for the purpose of design calculations.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	L		L						M	H	M	L
CO2	H	H	M	H	M	L	M					M	M	H	M
CO3	M	M	H	M	M	L	L					M	M	M	M
CO4	M	M	H	M	L	M		L	L			M	M	M	H
CO5	H	H	M	M		L	L	M	L			M	H	H	H

Unit 1: INTRODUCTION 9 Hours

Dimensions and units, Dimensional Consistency, Conservation of mass and energy Dimensional consistency-single and multiple-effectevaporator-vapour recompression- boiling point elevation-evaporation of heat-sensitive materials-evaporation equipments- simple problems.

Concentration-gas liquid equilibrium-solid -liquid eqn-eqn.concentration relationships-Gas absorption - rate-absorption equipment - equipments-Basket extractor, Dorr agitator-Decantation systems-extraction towers-Membrane separations.

Unit 2: CRYSTALLIZATION AND DISTILLATION 9 Hours

Crystallization-rate of crystal growth-equilibrium crystallization-equipments-types – operation -Distillation-flash and differential distillation-steam distillation-batch distillation- operation, and processes-factors influencing the operation.

Unit 3: SEDIMENTATION AND FILTRATION 9 Hours

Sedimentation-Gravitational sedimentation - Floatation-sedimentation of particles in gas, settling under combined forces-centrifugal separation -Filtration-sieving.

Unit 4: GRINDING AND MIXING 9 Hours

Grinding and cutting-various grinding equipments - Emulsification-preparation ofemulsions. Characteristics of mixtures - measurements of mixing - particle mixing-liquid mixing-mixing equipments.

Unit 5: HUMIDIFICATION AND AIR CONDITIONING 9 Hours

Basic concepts, psychrometric chart construction, Humidification and dehumidification operations, and design calculations, cooling tower principle and operation, types of equipment, design calculation

Text books:

1. McCabe, W.L., Smith, J.C., Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill, New York, 7th ed., 2005.
2. Brennan, J. G., Butters, J. R., Cowell, N. D. and Lilly, A. E., Food Engineering Operations, Applied Science, London, 3rd Edition, 1990.

References:

1. Coulson, J.M., Richardson, J.F, Backhurst J.R. and Harker J.M., Coulson and Richardson‟s Chemical Engineering, Volume I, Butter worth Heinemann, Oxford, New York, 5th Edition, 2002
2. David, M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, Prentice-Hall of India, New Delhi,7th Edition, 2004
3. Fellows, P. Food Processing Technology, Principles and Practice. Woodhead, Cambridge 2000, 2nd Edition.

FBT205	INSTRUMENTAL METHODS OF ANALYSIS FOR FOOD				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Program Core			
			Course Type	**:**	Theory			

Course Objective(s):

Provides students with an opportunity to identify different types of analytical instruments in their respective laboratories

Course Outcome(s):

CO1: Classify the methods and characteristics of measuring instruments.
CO2: Interpret the interaction of electromagnetic radiation and matter and their application in spectroscopy.
CO3: Relate the fundamentals of different surface spectroscopy.
CO4: Interpret the concept of TG and DSC.
CO5: Select the relevant chromatographic techniques in a sensible and effective way to separate and detect components in relation to their properties.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M		L	H		L					M	H	H	
CO2	M	L		M	M	M	M					M	H	H	
CO3	H	H		L	H	M	M						H	H	
CO4	H			L	M		L						H	H	
CO5	H	M		L	H	M	L					L	H	H	

Unit 1: **9 Hours**

Classification of methods - Calibration of instrumental methods - Electrical components and circuits - Signal to noise ratio - Signal - Noise enhancement - General design - Sources of radiation - Wavelength selectors - Sample containers - Radiation transducers - Types of optical instruments - Fourier transform measurements

Unit 2: **9 Hours**

Measurement of transmittance and absorbance - Beer's law - Spectrophotometer analysis - Qualitative and quantitative absorption measurements - Types of spectrophotometers – UV-Visible - IR - Raman spectroscopy - Principle, instrumentation and applications

Unit 3: **9 Hours**

X ray photoelectron spectroscopy (XPS) - Ultraviolet photo electron spectroscopy (UPS) - Electron impact spectroscopy and auger electron spectroscopy - Instrumentation radiation sources - Energy analysis - Detectors and auxiliary systems

Unit 4: **9 Hours**

Thermo gravimetric methods - thermo balance, derivative thermo gravimetric analysis - Differential thermal analysis - Differential scanning calorimetry

Unit 5: **9 Hours**

Introduction to chromatography - models, ideal separation, retention parameters Van - Deemter equation - Gas chromatography, stationary phases, detectors - Kovats indices - HPLC - pumps, columns, detectors - Ion exchange chromatography - Size exclusion chromatography - Supercritical chromatography - Capillary electrophoresis

Text books:

1. Willard, H., Merrit, L., Instrumental Methods and Analysis, CBS Publishers and Distributors, New Delhi, 7th Edition, 2004
2. Skoog, Holler and Nieman., Principles of Instrumental Analysis, Thomson Asia Pvt Ltd., Singapore, 5th edition, (Reprint) 2003

References

1. Chatwal, R.G., Anand, K.S., Instrumental Method of Chemical Analysis, Himalaya Publishing House, Mumbai, 5th Edition (Reprint), 2006
2. Ewing, G.W., Instrumental Methods of Chemical Analysis, McGraw Hill Company, NewDelhi, 5th Edition, 1989

FBT206	FERMENTATION BIOTECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Objective(s)

To provide students with the skill to produce some foods and drinks resulting from alcoholic or acidic fermentation process.

Course Outcome(s)

CO1: Explain food fermentation and types of microorganism responsible for fermentation
CO2: Identify suitable media and microorganism for food fermentation
CO3: Indicate the types of fermenter and preparation of inoculum
CO4: Classify fermenter and its function
CO5: Choose specific microorganism for the development of fermented foods.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L				L							H	L	
CO2	H	M	M	L		M						L	H	M	
CO3	H	M	M	L		L						L	M	M	
CO4	H		L	M									M		
CO5	H	H	H			L	H						H	H	L

Unit 1: INTRODUCTION TO FERMENTATION 9 Hours

Definition - benefit of fermentation - nutritive value of fermented foods - microbial changes in fermented foods - microorganism - proteolytic, liploytic and fermentative bacteria.

Unit 2: MEDIA FOR FERMENTATION 9 Hours

Selection of industrial importance microorganism. Media for industrial fermentation -Medium Composition - Energy, CO2, nitrogen and other growth factors, buffering and foam agents. Types of fermentation - Ethanolic fermentation - mixed alcoholic and acid fermentation - Lactic acid fermentation.

Unit 3: STERILIZATION 9 Hours

Principles, sterilization of fermentation media, fermenter - in-batch & continuous process - development of inoculum for industrial fermentation - criteria for transfer of inoculums - aseptic inoculation.

Unit 4: FERMENTOR 9 Hours

Basic functions of fermentor - Design of fermentor - types of fermentor - different parts -agitator, impellers, aerator, baffles, process control, function and maintenance of various parts of fermentor- fermentor accessories. Recovery and purifications of food products

Unit 5: FERMENTED FOODS 9 Hours

Curd, yoghurt, miso, shrikand, cheese, butter milk, dosa. Modern fermented products - Wine,beer, brandy, vinegar, baker's yeast, sauerkrauts, sausages, fermentation of milk, meat, fruits and vegetables. -Production of single cell protein

Text books:

1. Bailey, J.E., Ollis, D.F., Biochemical Engineering Fundamentals, McGraw Hill Publishers, New Delhi, 2nd Edition, 1986.
2. Shuler, M.L., Fikret Kargi, Bioprocess Engineering-Basic Concepts, Prentice Hall Pvt. Ltd., New Delhi, 2nd Edition, 2004.
3. Ashok Pandey, C Larroche, CR Soccol, E Gnansounou & P Nigam, (Editors), Comprehensive Food Fermentation Biotechnology, - Asiatech Publishers, Inc., New Delhi,2010.

Reference books:

1. Doran, P.M., Bioprocess Engineering Principles, Academic Press (An Imprint of Elsevier), New Delhi, 2nd Edition, 2005.
2. Peter, F., Stanbury, Stephen, J., Hall and A. Whitaker., Principles6ttttttttt of Fermentation Technology, Elsevier, Science and Technology Books, New Delhi, 2nd Edition, 2005.
3. James Lee, M., Biochemical Engineering, PHI, USA, e-Book Version2.1,2002

FBT207	NUTRACEUTICALS AND FUNCTIONAL FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

Describe the research on the health benefits of functional foods and nutraceuticals identifying strengths, limitations and future directions

Course Outcome(s):

CO1: Describe the functional foods and its properties
CO2: Illustrate the metabolic disorders and its relation with functional foods
CO3: Illustrate the food fortification for nutritional deficiency
CO4: Discuss the health benefits of fibres, antioxidants, peptides, vitamins etc.,
CO5: Compare the probiotics and prebiotics

Mapping of COs and Pos:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H									L	M	L	L
CO2	L	H		H		H	H					L	H		
CO3	M	H	H	H		H	H					M	H	M	
CO4	M	M				M	M					M	H	L	M
CO5	L		H										H	L	

Unit 1: **9 Hours**

Scope, importance and renewed emphasis on specialty foods, health foods, functional foods.Nutraceuticals, infant and baby foods, adolescent/ teen age foods, foods for pregnant ladies and nursing mothers, geriatric foods.

Unit 2: **9 Hours**

Food recommended and restricted in metabolic disorders and disturbances, gastrointestinaldisorders; fever and infection; liver, gall, bladder and pancreatic disturbances; blood, circulatory and cardiac diseases; urinary and musculoskeletal diseases; allergies.

Unit 3: **9 Hours**

Nutritional deficiencies and its correction trough fortification and supplementation of foods.Beneficial effect of spices, honey, spirulina etc.

Unit 4: **9 Hours**

Health benefits/ mode of action of PUFA/ gamma linolenic acids, antioxidants, dietary fiber,oligosaccharides, sugar alcohols, peptides and proteins, glycosides, alcohols, iso-prenoides and vitamins, choline, LAB, phenolics, flavonols, minerals

Unit 5: **9 Hours**

Transgenic plant foods with health claims. Prebiotics and Probiotics.

Text books:

1. Benzamin T.Burton, Human Nutrition, Mc Graw Hill, H.J.Heinz Co, 1976

Reference books:

1. Shubhanginio A. Joshi, Nutrition and Diabetics, Tata Mc Graw Hill Co Ltd 2009
2. Arnold E Bender, Nutrition and Diabetic Foods, Chem. Pub.Co. New York 4th edition,1962
3. P.S HOWE, Basic Nutrition in Health and Diseases, Saunders Company, London.1981

FBT208	TECHNOLOGY OF ANIMAL FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

- To understand need and importance of livestock and poultry industry
- To study structure, composition and nutritional quality of animal products

Course Outcome(s)

CO1: Describe the composition, quality and nutritional value of milk and milk products.

CO2: Explain the processing and grading of milk products

CO3: State the manufacturing process for evaporated, condensed milk and by product utilization.

CO4: Indicate the technology adopted for processing of meat and fish products

CO5: Select appropriate preservation techniques, packaging material for poultry and egg products

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L											M		
CO2	H	M	L			M	L					L	H	L	M
CO3	H	L	M			M	M	M				L	H	L	
CO4	H	M	H		M	M	M	H				M	M	M	M
CO5	H	M	M			M	M	H				H	H	H	H

Unit 1: FLUID MILK **9 Hours**

Composition of milk and factor affecting it. Physico-chemical characteristics of milk and milk constituents. Production and collection, cooling and transportation of milk. Packaging storage and distribution of pasteurized milk. Whole, Standardized, Toned, Double toned and skim milk. Test for milk quality and Adulteration. UHT processed milk, flavored, Sterilized milk. Cleaning and sanitization of dairy equipments.

Unit 2: MILK PRODUCTS: **9 Hours**

Definition, Classification, Composition and physico-chemical properties of cream. Production processes and quality control. Butter: Definition, Classification, Composition and methods of manufacture, Packaging and storage. Butter oil/Ghee. Ice cream: Definition, Classification and Composition, Constituents and their role. Preparation of mixes and freezing of Ice cream, Overrun, Judging, Grading, and defects of Ice cream.

Unit 3: EVAPORATED AND CONDENSED MILK: 9 Hours

Method of manufacture, Packaging and storage. Defects, Causes, and prevention. Roller and Spray Drying of milk solids. Instantization. Flow ability, Dustiness, Reconstituability, Dispersibility, Wet ability, Sink ability and appearance of milk powders. Manufacture of casein, Whey protein, Lactose from milk or use in formulated foods.

Unit 4: MEAT PRODUCTS: 9 Hours

Ante-mortem examination of meat animals, Scientific slaughtering, Post mortem changes, Tendering and curing of meat, Beef Mutton, Pork Sausages and other meat products. Catch, Handling and transportation of fish. Fish spoilage, Processing, Preservation of fish, Shell fish and other sea foods.

Unit 5: POULTRY PRODUCTS: 9 Hours

Poultry processing, Canning of poultry products. Physical, Chemical Nutritional and Functional characteristics of Egg. Causes of deterioration of quality of egg, Preservation and Processing of Egg. Manufacturing of egg white, Egg yolk and Whole Egg solids/powder.

Text books:

- Pruthi, J.S Quick Freezing Preservation of Foods Principles, Practices- Foods of Animal Origin, Allied Publishers, New Delhi, vol 1 1999.
- William T. Hubbert, Harry V. Hagstad, Elizabeth Spangler, Food Safety and Quality Assurance: Foods of Animal Origin, wiley, 2nd Edition, 1997

Reference books:

1. Mary E. Torrence, Richard E. Isaacson, Microbial Food Safety in Animal Agriculture: Current Topics, Iowa State Press, 2nd edition, 2003
2. Leo M.L. Nollet, Fidel Toldra, Sensory Analysis of Foods of Animal Origin, CRC Press,1st edition, 2010.

FBT284	FERMENTATION TECHNOLOGY LABORATORY			L	T	P	C
				0	0	3	2
Pre-Requisite	: NIL	Course Category	:	Program Core			
		Course Type	:	Practical			

Course Objective(s):

To provide students with the skill to produce some foods and drinks resulting from alcoholic or acidic fermentation process.

Course Outcome(s):

CO1: Demonstrate the different fermentation process
CO2: Distinguish the primary and secondary metabolites
CO3: Design the experiments using statistical tools
CO4: Relate rheological behavior of fermented foods
CO5: Develop fermented foods and evaluate its quality

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M						H	H	M		H	M	L
CO2	M	H	M			M			H	H	M		H	M	L
CO3	H	H	M	M	M				H	H	M		H	M	
CO4	H	H	M						L	L			H	L	
CO5	H	H				M			H	H	M		H	M	H

List of experiments:

1. Temperature effect on growth-estimation of energy of activation and Arrhenius constant for microorganisms. Batch, fed batch and continuous cultures a) Estimation of Monod parameters b) Pure and mixed cultures
2. Production of secondary metabolite by plant cells in a photo bioreactor.
3. Production of secondary metabolites in synthetic and complex industrial media
4. Production of wine by yeast
5. Production of Amino acid
6. Screening of process variables single dimensional search, Plackett Burman design, design expert etc.
7. Study of rheology of fermentation broth and power determination
8. Bread preparation
9. Microbial examination of canned foods
10. Microbial examination of curd
11. Microbial examination of processed fruit and vegetable products

FBT285	INSTRUMENTAL METHODS OF ANALYSIS LABORATORY - I				L	T	P	C
					0	0	3	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

Provides students with an opportunity to identify different types of analytical instruments in their respective laboratories.

Course Outcome(s):

CO1: Demonstrate the precision, accurancy and LOD of instruments for calibration
CO2: Show the different application of UV spectroscopy
CO3: Relate the fundamentals of different surface spectroscopy.
CO4: Estimate the BOD and COD
CO5: Compare the different chromatographic techniques in a sensible and effective way to separate and detect components

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H						M	M	M	M	H	H	M	
CO2	H	M	M	M	H	L		L	H	H	M	H	H	M	M
CO3	H	M	L	M	M	L			H	M	M	L	H	M	M
CO4	H	M	L			L			H	H	M	L	H	M	M
CO5	H	H	H	M	H	M	M		H	H	M	L	H	H	H

1. Precision and validity in an experiment using absorption spectroscopy
2. Validating Lambert-Beer's law using KMnO4
3. Finding the molar absorptivity and stoichiometry of the Fe (1, 10 phenanthroline) 3 using absorption spectrometry
4. UV spectra of nucleic acids
5. Estimation of SO-4 by nephelometry
6. Limits of detection using aluminium alizarin complex
7. Estimation of Na, K, Li ions using flame photometry
8. Estimation of BOD and COD
9. Estimation of suspended solids and dissolved oxygen
10. Chromatography analysis using TLC
11. Chromatography analysis using column chromatography

CHE292	UNIT OPERATION IN FOOD PROCESSING LABORATORY				L	T	P	C
					0	0	3	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

This course aims at making the students understand the fundamental principles and concepts of heat transfer and mechanical operation in biochemical processes.

Course Outcome(s):

CO1: Calculate size reduction ratio, grindability index using ball mil land jaw crusher.
CO2: Examine the performance of separation devices - oil extractor, belt separator and distillation unit.
CO3: Find the performance of evaporator and mixing unit
CO4: Demonstrate the solid liquid separation in industrial equipment on the basis of settling, density and centrifugal force
CO5: Estimate the mean specific resistance using vacuum filter and terminal velocity of foods using Settler.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M						L		L	M	H	H	L
CO2	H	H	M	M	M				M	M	M	M	H	H	L
CO3	H	H	M		M				M	H	H	M	H	H	L
CO4	H	H	M	M	M				H	H	M	M	H	H	L
CO5	H	H	M		M				L		L	M	H	H	L

List of experiments:

1. Experiments on size reduction of fibrous food
2. Experiments on centrifugal separation (cream separator)
3. Experiments on pulse milling
4. Experiments on oil extraction by oil expeller
5. Experiments on oil extraction by Soxhlet apparatus
6. Experiments on pneumatic separation
7. Experiments in rotary flash evaporator
8. Experiments on determination of terminal velocity of foods
9. Experiments of mixing solid with solid
10. Experiments on inclined belt separator
11. Experiments using belt conveyor
12. Experiments on batch distillation process
13. Determination of mean specific resistance of the cake in a vacuum filter
14. Performance evaluation of screw conveyor
15. Performance evaluation of bucket elevator
16. Determination of particle size by sieve analysis
17. Study of drying characteristics of the given material by fluidized bed drying

CHE353	HEAT AND MASS TRANSFER				L	T	P	C
					3	1	0	4
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory with tutorial			

Course Objective(s):

- To introduce a basic study of the phenomenon of heat and mass transfer
- To develop methodologies for solving a wide variety of practical engineering problems.

Course Outcome(s):

CO1: Describe the various modes of heat transfer and Principles of conduction heat transfer under steady state condition.
CO2: Solve real time problems on free and forced convection system.
CO3: Examine the performance of heat exchangers
CO4: Evaluate the amount of heat transfer through radiation with/without shield unit.
CO5: Explain the various forms of mass transfer and its analogy with heat transfer.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		M								L		L	
CO2	H	M	M	M								L		M	
CO3	H	H	H	M								L	H	H	H
CO4	H	H	M	M								L	H	H	M
CO5	H	M		M								L	M	H	M

Unit 1:

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

Unit 2:

Heat flux, average temperature of fluid stream, overall heat transfer coefficient, LMTD, individual heat transfer coefficients, relationship between individual and overall heat transfer coefficients. Concept of heat transfer by convection, natural and forced convection, application of dimensional analysis for convection, heat transfer to fluids without phase change: heat transfer coefficient calculation for natural and forced convection, heat transfer to fluids with phase change: heat transfer from condensing vapours, dropwise and film-type condensation, heat transfer coefficients calculation for film-type condensation.

Unit 3:

Typical heat exchange equipment, counter current and parallel-current flows, enthalpy balances in: heat exchanges, total condensers. Double pipe exchanger, single-pass 1-1 exchanger, 1-2 parallel-counter flow exchanger, 2-4 exchanger, heat transfer coefficients in shell-and-tube exchanger, coefficients for crossflow, correction of LMTD foe crossflow. Condensers: shell-and-tube condensers, kettle-type boilers, Calculation of number of tubes in heat exchangers

Unit 4:

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

Unit 5:

Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion: of A through non-diffusing B, equimolal counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through non-diffusing B, equimolal counter diffusion. Effect of temperature and pressure on diffusivity.

Text books:

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, "Unit Operations of Chemical Engineering", 6th Edn., McGraw Hill International Edition, NewYork 2001
2. Donald Q. Kern, "Process Heat Transfer", Tata McGraw Hill Book Co., New Delhi, 1997
3. Robert E. Treybal, "Mass-Transfer Operations", 3rd Edn., McGraw Hill International Edition, Singapore, 1980

Reference books:

1. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., "Coulson & Richardson's Chemical Engineering", Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999

FBT301	CROP PROCESSING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

- To teach Technology of milling of various cereals
- To impart technical knowledge of pulses and oil seed refining

Course Outcome(s):

CO1: Illustrate the Unit operations involved in processing of paddy
CO2: Use the appropriate technique for processing wheat and corn
CO3: Describe the pulse processing methods
CO4: Select the method for processing various plantation crops
CO5: Recall process line for processing major spices and potato.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M									M	H		L
CO2	H		L			L	M					M	H	M	M
CO3	H	M	H			H	M					M	H	L	M
CO4	M	M	H			L		M				M	M	L	M
CO5	M	M	H			H	M	M				M	M	M	M

Unit 1: PADDY PROCESSING AND EQUIPMENTS 9 Hours

Rice - variety - consumption - nutritive value - parboiling of paddy -traditional methods - Unit operations involved in parboiling - CFTRI Method, Pressure Parboiling, Dry heat parboiling - advantage of modern methods - storage of rice and paddy - Cleaner and grader- Cylinder separator, Spiral separator, Color sorter, Inclined belt separator.

Unit 2: PROCESSING OF WHEAT, CORN AND MINOR MILLET 9 Hours

Wheat milling - types - tempering, break and reduction rolls, purifiers and sifters, flour blending, corn milling - wet milling, dry milling, high fructose corn syrup, corn starch, oats processing- Extruded products, breakfast cereals. Processing of sorghum, ragi, barley - malting of barley - processed products.

Unit 3: PULSE PROCESSING 9 Hours

Types of legumes and pulses - chemical composition, pretreatments of pulses – commercial methods of dehulling - dry and wet grinding of pulses - machinery used for dhal milling - roasting and parching of pulses - processed products of pulse.

Unit 4: PROCESSING OF PLANTATION CROPS 9 Hours

Processing of tea - black tea, Green tea, Oolong tea, flavored tea. Coffee - processing - instance coffee. Processing of cashew nut, coconut, oil palm, areca nut, cocoa - Equipments used - products.

Unit 5: PROCESSING OF SPICES AND TUBER CROPS 9 Hours

Processing of pepper, chilli, turmeric, cardamom. Tuber crops- tapioca, potato processing – Processed products.

Unit 6: PRESERVATION OF FRUITS AND VEGETABLES 9 Hours

Drying - importance - pretreatments before drying - drying curve - shrinkage, case hardening, Cold storage - cooling load calculation - evaporation cooling - types - waxing, canning, bottling.

Text books:

1. N. L. Kent, A. D. Evers, Kent‟s Technology of Cereals, Pergamon Press, 2nd Edition, 1994.
2. R y a l l and Lipton, Handling, Transportation, storage of fruits and Vegetables", Vol.1, AVI Publishing co., 2nd Edition, 1993.
3. Tressler and Josl YU, "Fruits and Vegetables Juice processing Technology", AVI publishing co.

Reference books:

1. Donald B. Brooker, Fred W. Bakker-Arkema, Carl W. Hall Drying and storage of grains and oilseeds, AVI Books, 1992.
2. Sivetz and Foote, Coffee processing Technology, AVI publishing Co., 1958
3. Talburt and Smith, Potato processing, AVI publishing co, 1975

FBT302	OPTIMIZATION TECHNIQUES IN FOOD TECHNOLOGY			L	T	P	C
				3	1	0	4
Pre-Requisite	:	NIL	Course Category :	Program Core			
			Course Type :	Theory with tutorial			

Course Objective(s):

To understand the concepts and origin of the different optimization methods

Course Outcome(s):

CO1: Optimize Engineering application for effective outcomes
CO2: Apply Mathematical interpretation in transportation problems saves time and Money
CO3: Use different tool to organize and handle projects effectively
CO4: To analyze problems and sort based on priority in Process flow
CO5: To perform sensitivity analysis with judgmental solution

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L										L	M	L	
CO2	L	M											L	L	L
CO3						M							M		
CO4		M				L							L	M	
CO5	L	M	L			L								L	

Unit 1: INTRODUCTION:

Engineering applications of optimization, statement and classification of optimization problem, single variable and multi variable optimization with and with constraints

Unit 2: LINEAR PROGRAMMING

Formulation of linear programming problem, graphical approach, general linear programming problem, simplex method, duality in linear programming and transportation problems.

Unit 3: PROJECT SCHEDULING

Project scheduling by PERT and CPM, network analysis

Unit 4: SEQUENCING THEORY

General sequencing problem jobs through 2 machine and 3 machines and 2 job through n machines.

Unit 5: DYNAMIC PROGRAMMING

Introduction, principle of Optimality. Formulation and solution of Dynamic Programming problems. Traveling salesman's problems. Application to transportation problem and linear programming problems.

Text books:

1. Edgar, T.F, Himmelblau, D.M, Ladson, L.S., Optimization of Chemical Practice, McGraw Hill International , New York, II Edition., 2003
2. Diwaker, U.M., Introduction to Applied optimization, Kluwer Academic Publication, London, 2003
3. Joshi, M.C, Moudgalya, K.M., Optimization, Theory and Practice, Narsoa Publication, New Delhi, 2004

Reference books:

1. Singiresu, S.Rao., Engineering optimization - Theory and practices, John Wiley and Sons, Singapore,3rd edition,1996
2. Ravindran, Phillips, Solberg., Operations Research, Principles and Practice, John Wiley and Sons, Singapore, 1987
3. Fredick, S.H, Liberman, G.J., Introduction to Operations Research, McGraw Hill Inc, New York, 1995

FBT304	TRADITIONAL & FERMENTED FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

To understand various concepts, principles and procedures involved in the area of fermented food production

Course Outcome(s):

CO1: Discuss the importance of food and its relationship with culture in India
CO2: Indicate the microbes involved in the production of fermented foods
CO3: Illustrate fermentation techniques in milk, meat and fish products.
CO4: Explain the production of fermented food beverages
CO5: Discuss the production of microbial protein, enzymes and baker's yeast

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L													M	M
CO2	M	L	L	L		M	L						H	M	H
CO3	H	L	M	L		M	M						M	L	M
CO4	H		L	L		M	M						M		H
CO5	H	L	H	M		H	M						H	L	H

Unit 1: TRADITIONAL FERMENTED FOODS

Indian traditional sweet, savory and snack food products: Sweetmeats, Namkins, Papads Idli and Dosa.

Unit 2: CULTURE MAINTENANCE

Preparation and Maintenance of Bacterial, Yeast and Mold cultures for food fermentations. Probiotics - Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

Unit 3: FERMENTED PRODUCTS

Fermented Dairy Products: Cheeses, Curd and Yoghurt, Butter milk and the fermented milks. Spoilages and defects of fermented dairy products and their control. Fermented meat and fish products, Oriental fermented foods

Unit 4: FERMENTED DRINKS

Fermentative Production of Beer, Wines, Cider and Vinegar, distilled spirits (eg. Rum, gin,whisky), Fermented Vegetables (Pickles).

Unit 5: MICROBIAL PROTEINS

Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes (eg. Amylases,protease, lipases, pectinases, rennin), HFCS(High Fructose Corn Syrup)

Text books:

1.K.H. Steinkrus, Handbook of Indigenous Fermented Foods, Marcel Dekker publisher,1983.
2.Sukumar De, Outlines of Dairy Technology , Oxford University Press N Delhi , 1991.
3.Prescott and Dunn, Industrial Microbiology, Agrobios (India) publisher, 2009

REFERENCES:

1.L.E.Casida, Industrial Microbiology, New Age International(p) Ltd N Delhi, 2007
2.W.C.frazier and D.C.Westhoff, Food Microbiology, Tata Mcgraw Hill publisher, 3rd edition , 2008.

FBT381	FOOD PRESERVATION AND PROCESSING LABORATORY - II				L	T	P	C
					0	0	4	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Outcome(s)

CO1: Demonstrate low and high temperature food preservation methods
CO2: Carry-out different food preservation techFniques to process foods.
CO3: Develop value added products from fruits and vegetables.
CO4: Develop ready to serve foods (RTS) products.
CO5: Choose the specific ingredients for development of speciality foods.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M	L					H	L			H	L	M
CO2	H	M	M	L					H	L		M	H	L	M
CO3	H	M	H	M		M			H	H	L	L	H	M	M
CO4	H	M	H	M		M			H	H	M	L	H	M	M
CO5	H	M	H	M		H			H	H	L	M	H	M	M

List of experiments:

1. Pretreatments on Fruits and Vegetables
2. Experiments on drying using tray drier and Fluidized bed dryer
3. Experiments on juice extraction
4. Experiments on canning of fruits and vegetables
5. Experiments on different methods of cooking vegetables -Microwave, Pressure & Ordinary
6. Experiments on Osmotic Dehydration
7. Experiments on preparation of Jam
8. Preparation of crystalline and glazed candies
9. Preparation of tomato sauce and ketchup
10. Studies on factors influencing gelatinization of starch
11. Experiments on different methods of cooking pulses.

CHE391	MASS TRANSFER OPERATIONS LABORATORY				L	T	P	C
					0	0	4	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

To introduce the mass transfer principles

Course Outcome(s)

CO1: Estimate the perormance of Ion Exchange and membrane separation unit.

CO2: Perform Distillation Operations

CO3: Study on fractionating Column, Absorption and Crystallization unit.

CO4: Demonstrate the Liquid-Liquid & Liquid-Solid Separation process.

CO5: Examine the Performance of flash vaporization and concept of VLE

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L						L	L		M	M	M	
CO2	H	M	L						L	L		M	M	M	
CO3	H	M	L						L	L		M	M	M	
CO4	H	M	L	M					L	L		M	M	M	
CO5	H	M	L	M					L	L		M	M	M	

List of experiments:

1. Separation factors of the experiments with differential distillation.
2. Separation factors of the experiments with flash vaporization.
3. Separation factors of the experiments with vapour liquid equilibrium.
4. Separation factors of the experiments with liquid – liquid extraction.
5. Separation factors of the experiments with solid –liquid extraction.
6. Separation factors of the experiments with ion exchange.
7. Separation factors of the experiments with membrane separation.
8. Studies on Bubble cap/ tray/ fractional column.
9. Studies on Absorption/ Humidification/ Dehumidification columns.
10. Studies on crystallization and adsorption.

FBT305	FOOD PROCESS EQUIPMENT DESIGN				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):
Ability to decide the various handling and process equipment

Course Outcome(s):
CO1: Explain the details of Material composition for effective construction of various food processing equipment
CO2: Relate the material handling capacity and quality of materials in designing Conveyor belts and Elevators
CO3: Illustarte the principle of pressure vessels suitable for food processing industry
CO4: Interpret the working principle of various pressure vessels equipments.
CO5: Use computer applications in desiging the food processing equipments.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M			L	M						H	L	M
CO2	H	M	H		M	L		L					H	M	M
CO3	H	H	H	H		L		L	L	L		M	M	H	H
CO4	H	H	H	H	H	M	M	L	L	L		M	M	H	H
CO5	H	H	H	H	H	M	M	L	H	H	M	M	M	H	M

Unit 1:
Introduction to various mechanical properties of materials to be used as material of construction, resistance of metals to corrosion under varying conditions of temperature and pressure etc. Application and use of various codes and standards in design.

Unit 2:
Design of material handling equipment: Belt conveyor, bucket elevator, screw conveyor, cyclone conveyor, chain conveyor, pneumatic conveyor. Design of seed processing equipments: Air screen cleaner, rotary cleaner, graders based on size shape and surface produce handled, seed treater.

Unit 3:
Design of non-pressure storage vessel, tall vertical vessels, unfired pressure vessels with internal pressure: storage vessels and process vessels.

Unit 4:
Design of unfired pressure vessels with external pressures, end closures, flat plates, domed ends, torispherical, ellipsoidal, hemispherical and conical ends. Design of nozzles, openings and reinforcements, Bolts, flanges, gaskets.

Unit 5:

Bolted flanges, pipe line design and Mechanical design of selected process equipments such as heat exchangers, Evaporators, Distillation columns, Absorbers, Reactors and Dryers and Crystallizers; Use of softwares for design of equipments.

Text books:

1. Peters Max. S., Timmerhaus Klaus D.and Ronald E West., Plant Design and Economics for Chemical Engineers, V Edition McGraw Hill.2003
2. Coulson, J. M. and Richardson J. F., Chemical Engineering, Pargamon Press, vol. 6 1989.

Reference books:

1. Evans, F. L., “Equipment Design Handbook”, Gulf Publishing Company, 2 Edition 1979.
2. Perry, R.H and Chitton, Perry's Chemical Engineers Handbook, McGraw Hill, NewYork, 7th Edition, 1997.

FBT306	FOOD QUALITY CONTROL				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

To ensure the safety of food for safe consumption

Course Outcome(s):

CO1: Explain the types of hazards and preservatives in food Products
CO2: Illustrate standards for chemical and microbial standards in Food Industry
CO3: Assess the quality food products
CO4: Explain the various quality management system in foods
CO5: Apply different sampling and statistical methods

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H		H		L	M						L		
CO2	H	L			M	M	L	L				M	H	M	M
CO3	H	M			M	L	M	L				L	H	L	H
CO4	M	L	L	M	H	H	M	L	M	M	M	M	M	L	H
CO5	M	L				M						M		H	M

Unit 1: **9 Hours**

Methods of food quality evaluation - risk analysis - Food safety testing. Types of adulterants-test to detect adulterants in foods - metal contaminants - types of hazards - physical, chemical and biological - Food additives and preservatives - antioxidants, sweeteners flavours, colours, vitamins, stabilizers - pesticidal residue analysis - Food toxins.

Unit 2: **9 Hours**

Reference and standard methods for chemical and microbiological analysis-The role of IUPAC, ISO, IDF, etc.-Comparison of newer and rapid methods with reference methods for protein, fat, water and microorganisms.

Unit 3: **9 Hours**

A review of the methods available for authentication of meats, dairy products and culinary oils.

Unit 4: **9 Hours**

Concepts of quality, quality assurance and quality control- Quality management systems, total quality management-Hazard analysis, critical control points (HACCP) and its developments-The EFSIS Standard for Companies Supplying Food Products- The British Retail Consortium (BRC) Technical Standard for Companies Supplying Retailer Branded Food Products- The British Meat Manufacturers‟ Association (BMMA) Standard for Meat Manufacture.

Unit 5: 9 Hours

The range of sampling plans and choice of appropriate plan-100% inspection, 'on-line' Inspection-Statistical sampling, control charts and their uses

Text books:

1. Ronald S Kirk and Ronald Sawyer., Pearson's Composition and analysis of foods, 9th edition, Wiley, 1991
2. Pomeranz Y & Meloan C E., Food analysis: Theory and practice, , Chapman & Hall, New York, USA , 2nd & 3rd editions,1994

Reference books:

1. Bhatnagar, D. and Cleveland, T. (Eds.)., Molecular Approaches to Improving Food Quality and Safety, Van Nostrand Reinhold, New York ,1st edition,1992
2. Finley, J., Robinson, S. and Armstrong, D. (Eds.)., Food Safety Assessment. American Chemical Society, Washington D.C, 2nd editions ,1992
3. Birch, G. and Campbell-Platt, G. (Eds.), Food Safety - the Challenge Ahead, Intercept Ltd., Andover, England ,1993.

FBT307	FOOD PACKAGING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Program Core			
			Course Type	**:**	Practical			

Course Objective(s):

To study about the functions of packaging along with the influence of various factors on food.

Course Outcome(s):

CO1: Indicate the role and importance of food packaging
CO2: Classify paper and plastic packaging and its importance.
CO3: Illustrate glass and metal container for food packaging
CO4: Explain the manufacturing process for metal container.
CO5: Represent various laws and regulation related to food packaging.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L				M						L		H
CO2	M	H	L	L			H					L	H	H	H
CO3	M	M	M	L		L	L					L	H	M	M
CO4	M	M	M	H	L			L				L	H	M	
CO5			H			H	M	M				M	M	L	H

Unit 1:

Basic Concepts: Concept of packaging, Functions of a Food Package, Package development factors and Food package development. Aseptic Packaging.

Unit 2:

Cellulosic and Polymeric packaging materials and forms: Food grade polymeric packaging materials, Rigid plastic packages- Regenerated cellulose film- plastic films- Aluminium foils and laminations- Special packaging methods- vacuum and gas packaging, shrink package, retort pouches- Bio degradable packages.

Unit 3:

Glass and Metal containers: Glass: Composition, Properties, Bottle making and Closures for glass containers - Metal: Bulk containers, Tin-plate containers, Tin free steel containers, Aluminium containers-Latest development in metal cans and protective lacquers.

Unit 4:

Canning of food products- types of cans- open top sanitary cans- tin plate grades- lacquering and sealing compounds for OTS cans- canning operations- can washing and sterilization- exhausting- seaming- reforming and flanging operations- retorting of cans.

Unit 5:

Package printing, Packaging Laws and Regulations, Evaluation of food packaging materials and package performance.

Text books:

1. Painy, F.A. and Painy, H.Y., A Handbook of Food Packaging, Leonard Hill, Glasgow, UK, 1983
2. Scicharow, S. and Griffin, R.C., Food Packaging. AVI, Westport, 1st edition,1970

Reference books:

1. Frank Albert Paine, Heather Y. Paine., A handbook of food packaging, Blackie Academic and Professional, 2nd editions, 1992
2. Gordon L. Robertson., Food packaging, CRC press, 2nd editions,1996
3. R Coles, D McDowell and M.J. Kirwan., Food packaging technology, Blackwell Publishing, CRC Press, Oxford, 2003.

FBT382	FOOD PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY				L	T	P	C
					0	0	4	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Objective(s): To design and develop equipments used in food processing operations

Course Outcome(s):

CO1: Design agitators and vessels depending on food product

CO2: Design Heat exchangers and evaporator Equipments based on capacity and types of food materials handled

CO3: Design drying equipment used in food process operation

CO4: Adapt Separation methods effectively in food industry

CO5: Use Computer application for effective design and simulation and cost cutting

Mapping of COs and POs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	H						M				M	M	
CO2	H	M	H						H	M			M	M	
CO3	H	M	H						H	M	M		M	M	
CO4	H	M	H						M	M			M	M	
CO5	H	M	H						L	M			M	M	

Unit 1: VESSELS & AGITATORS

Detailed design and drawing of enclosures, supports and standard flanges, storage vessels reaction vessels. Detailed design and drawing of various types of agitators used in Food process equipments.

Unit 2: HEAT EXCHANGERS & EVAPORATORS

Detailed design and drawing of various types of heat exchangers & Evaporators employed in Food process operation.

Unit 3: DRYERS

Detailed design and drawing of dryers used in Food process operation.

Unit 4: CRYSTALLIZERS

Detailed design and drawing of crystallizers used in Food process operation.

Unit 5: BASKET CENTRIFUGE AND FILTER PRESS

Detailed design and drawing of basket centrifuge and filter press used in Food process operation.

Text books:

1. Sinnott, R.K., Coulson & Richardson's., Chemical Engineering, Butterworth Heinemann, New Delhi, Volume 6, 3rd Edition ,1999

Reference books:

1. Perry, R.H., et al., Perry's Chemical Engineers Handbook, 7th Edn., McGraw Hill, NewYork, 1997
2. Joshi, M.V., and Mahajan, V.V., "Process Equipment Design", Macmillan India Limited, New Delhi, 3rd Edition, 1996
3. Brownell, L.E., and Young, E.M., "Process Equipment Design", Wiley Eastern, 1968

FBT383	FOOD QUALITY EVALUATION LABORATORY				L	T	P	C
					0	0	4	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Outcome(s):

CO1: Identify the microbial loads of given food samples

CO2: Estimate the microbial count in the food using microscope and serial dilution methods

CO3: Interpret the total microbial count in different food products

CO4: Demonstrate the growth curve of microbes

CO5: Determine the effect of enzyme activity in food quality

Mapping of COs and Pos

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L				L		L	M				H		M
CO2	H	M				M			M	M		M	H		H
CO3	H	M				M			M	M		M	H	L	H
CO4	H	L	M			M			H	H			M		
CO5	H	L	M			L		L	M				M	L	M

List of experiments:

1. Study of the microbiological quality of milk by MBR test
2. Estimation of total microbial bacterial plate count of food sample by direct microscopic and SPC method
3. Determination of changes in pH and acid values in storage of milk
4. Estimation of total microbial bacterial plate count of food sample by SPC method
5. Estimation of total microbial count - yeast and mould.
6. Estimation of total microbial count of (a) milk products (b) fruits and vegetable products (c) meat, fish and poultry products (d) water (e) surface (f) air (g) workers (h) canned foods
7. Study of the growth curve of micro-organisms
8. Demonstration of effect of different anti-microbial agents i.e. (a) high and low temperature (b) UV radiation and (c) chemical preservatives on the growth of microbes
9. Determination of diastase enzyme activity

CHE451	INSTRUMENTATION AND PROCESS CONTROL			L	T	P	C

Pre-Requisite	:	NIL	Course Category	:	Program Core
			Course Type	:	Practical

Course Outcome(s)

CO1: Describe the basic principle, construction and operation of instruments
CO2: Explain the control instruments and its function
CO3: Recognize the different process instrumentation diagrams of various equipment
CO4: Compare the different types of loop systems
CO5: Select the available mathematical test for testing the stability of the system.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	M	L								M	M	M	
CO2	H	H	M	L	M	H						M	M	M	
CO3	H	H	M	L		M	L	M				M	M	M	
CO4	M	H	M	L	H	H	L	M				M	M	M	
CO5	H	H	M	L	M	M	L					M	M	M	H

Unit 1:

Introduction of process variables, static and dynamic characteristic of instruments and their general classification. Elements of measuring system and their function, principles, construction and operation of instruments for the measurements, transmission, control/ indication / recording of process variables like pressure, flow, level, humidity and composition. Principles of transducers: electropneumatic, pneumatic, electrical and multipressure.

Unit 2:

Construction and characteristics of final control elements such as proportional, integral, PD, PID controllers, pneumatic control valve, principles and construction of pneumatic and electronic controllers.

Unit 3:

Process instrumentation diagrams and symbols, process instrumentation for process equipments such as distillation column, heat exchangers, fluid storage vessel. Dynamic behavior of first order, second order and two or more first order systems in series.

Unit 4:

Laplace Transform, Linear open loop system, first and second order system and their transient response. Interacting and non interacting system. Transportation lag, linear closed loop system, block diagram of closed loop transfer function, controllers, transient response of closed loop systems.

Unit 5:

Stability concept, Routh stability criterion, relative stability, huwitz Stability criterion, Nyquist‟s criterion. Root locus technique, introduction to frequency response, Bode diagrams, Bode stability criterion, gain and phase margins, Ziegler Nicholas controller setting.

Text books:

1. Coughnowr, D. R., Process Systems Analysis and Control, Mc Graw Hill, New York, 2nd Edition, 1991
2. George Stephanopolous, Chemical Process Control, Prentice-Hall of India Pvt-Ltd., New Delhi, 1990

Reference books:

1. Doeblin Ernest , Measurement Systems, Mc Graw Hill, New York , 2005
2. C. A. Smith and A. B. Corripio, Principles and Practice of Automatic Process Control, John Wiley and Sons, New York, 2nd Edition, 1997.
3. Luyben, M. L., Luyben, W. L., Essentials of Process Control, Mc Graw Hill, New York, 1997
4. Eckman, D.P., Industrial Instrumentation, John Wiley and Sons, Singapore, 1990
5. Harriot, P., Process Control , Tata McGraw Hill, New Delhi, 1984

FBT401	REFRIGERATION AND AIR CONDITIONING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Theory			

Course Objective(s):

To understand the various concepts behind cold storage construction, Design, maintenance and application in food industry.

Course Outcome(s):

CO1: Explain the basics of refrigeration with thermodynamic principles

CO2: Illustrate the various cooling compression refrigeration systems and calculate the capacity and coefficient of performance

CO3: Identify various components of refrigeration system and its types

CO4: Determine heat loads and heat losses in heating and cooling food process systems

CO5: Apply cold chain and refrigeration for storing different food products

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M	M		M						M	H		H
CO2	H	H	M	M		M						M	H		H
CO3	M	M				M							H		M
CO4	H	H	M	M		H						L	H	H	H
CO5	H	H	M	M	M	H	M				L	L	H	H	H

Unit 1: **9 Hours**

Review of thermodynamic principles of refrigeration-Simple vapour compression system-analysis-Method for improving COP - Multistage and multiple evaporator system - Cascade system - COP comparison.

Unit 2: **9 Hours**

Absorption refrigeration cycle - Water lithium bromide systems - ammonia absorption refrigeration system - COP calculation of single effect absorption system - Refrigeration absorbent combinations-comparison of absorption system with vapour compression systems.

Unit 3: **9 Hours**

Compressors - Condensers and Cooling towers - Evaporators-Expansion devices. Refrigerants: properties - selection of refrigerants-alternate refrigerants. Refrigeration plant controls- Testing and charging of refrigeration units.

Unit 4: **9 Hours**

Different heat sources - Conduction and radiation load-occupants load - Equipment load- fresh air load in filtration-air load- estimation of total load, bypass factor consideration- effective sensible heat factor (ESHF) - cooling coils and dehumidifier air washers.

Unit 5: 9 Hours

Preservation of different products-ice factory-dairy plant refrigeration systems-air conditioning of hotels and restaurants-air conditioning of theatres and auditorium-air conditioning of hospitals

Text books:

1. Arora, S. C. and Domkundwar, S., A course in Refrigeration and Air conditioning, Dhanpat Rai (P) Ltd., New Delhi, 1997
2. Khurmi R.S., and Gupta, J. K., A text book of Refrigeration and Air Conditioning, Eurasia Publishing housing (P) Ltd, New Delhi, 2002

Reference books:

1. Manohar Prasad, Refrigeration and Air conditioning, New Age International (P) Ltd, New Delhi, 1999
2. Stoecker, W. F. and Jones J. W., Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1986
3. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th edition, 2001
4. Arora, C. P., Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi,2002

FBT491	FOOD ENGINEERING LABORATORY				L	T	P	C
					0	0	4	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

To understand the principle and working of various food engineering operation and machinery

Course Outcome(s):

CO1: Demonstrate the thermal processing method
CO2: Determine the drying rate of foods
CO3: Carry-out the low temperature methods for food preservation
CO4: Asses the physical and rheological properties of food
CO5: Compute the heat and mass transfer in food processing

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	M	L		L			H	L	L		H	M	
CO2	H	H	H	M	L	M		M	M	L	L		M	H	
CO3	H	M	H	H	M	M			H	M	M		H		M
CO4	H	M	H	H	M	M		L	M	M	M	L	H	H	H
CO5	H	H	M	H		L		M	M	M	L		M	M	H

List of experiments:

1. Determination of b, Z and F value in thermal processing
2. Determination of drying rate of given food materials
3. Experiments on in-pouch sterilization of milk
4. Experiments on extrusion cooking
5. Experiments on microwave cooking
6. Experiments on freezing of foods
7. Experiments on peeling of potatoes- Lye peeling and mechanical peeler
8. Experiments on determination of firmness of foods
9. Experiments on determination of physical properties of foods
10. Experiments on production of whey beverage
11. Determination of heat transfer coefficient of parallel flow heat exchanger
12. Determination of heat transfer coefficient of plate heat exchanger
13. Study of rheological properties of foods.
14. Study of freezers and freeze dryers. Design problems on batch freezers. Design problems for continuous freezers.
15. Design problems on dryer

CHE491	PROCESS CONTROL LABORATORY				L	T	P	C
					0	0	4	2
Pre-Requisite	:	NIL	Course Category	:	Program Core			
			Course Type	:	Practical			

Course Objective(s):

To introduce the key concepts in automatic control and instrumentation of process plants

Course Outcome(s):

CO1: Understand the basic principles and importance of process control in industrial process plants

CO2: Specify the required instrumentation and final elements to ensure that well tuned control is achieved

CO3: Design and tune process controller

CO4: Understand the use of block diagrams for the design of control systems

CO5: Understand the importance and application of food instrumentation for the efficient design of process control lubes for process engineering plants.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M							H		M	H		
CO2	M	H	M						H	M		L	M		
CO3	M	M	L						H	H		M	M		
CO4	M	M	M						M			L	M		
CO5	M	H	H						H	H		L	L		

List of experiments:

1. Characteristics of control valve.
2. Time constants of Manometers.
3. Time constants of Thermometers.
4. Temperature Measurement and calibration of thermocouple.
5. Interacting & and Non-interacting systems.
6. Flow control Trainer.
7. Temperature control Trainer.
8. Pressure control trainer

MAJOR ELECTIVES

FBT308	COMPOSITION, QUALITY & SAFETY OF FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Major Elective			
			Course Type	**:**	Theory			

Course outcomes:

On Successful completion of course students can be able to

CO1: asses the nutritional quality of food and composition

CO2: Evaluate the sensory quality results with instruments

CO3: Set up quality management system in food industry

CO4: Inspect from Raw material to final product in process flow

CO5: Analysis of undesirable constituents in food during processing

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M			M		H							L	L	
CO2	M	M		H									L	L	
CO3									M	M			M	L	
CO4		M		H									L	L	
CO5		H											L	L	

Unit 1: INTRODUCTION **9 Hours**

Ways of describing food quality: Composition, appearance, kinesthetic and flavour attributes. Nutritional quality of foods and its assessment (content and quality of nutrients). Microbiological quality of foods.

Unit 2: SENSORY **9 Hours**

Sensory quality and its evaluation, instrumental measurement of sensory attributes such as color, viscosity, texture etc.

Unit 3: QUALITY CONTROL **9 Hours**

Quality control, quality assurance and total quality management in food industry.

Unit 4 **9 Hours**

Defects in food quality, its sources, classification, prevention and control. Statistical quality control. Quality costs.

Unit 5: **9 Hours**

Anti-nutritional factors in food. Undesirable constituents developing in Process and storage of food. Microbial contamination, pesticide residues, concept of HACCP, physical, chemical and microbiological safety of food.

Text books:

1. Hubbard, Statistical Quality Control in the food industry, CBS Publisher and Distributors, New Delhi, 3rd edition, 2003
2. Mark Clute, Quality Control for the food industry, CRC press, Nov 2008.
3. Vk Joshi, Sensory Science: Principles and Application in Food Evaluation, Agrotech Books,2nd edition, 2006

Reference books:

1. Elena Castell-perez, Ljubica Dokic, Petar Dokic, P.W.Vowsy, Rheology Applications To Food Quality And Product Development, Blackwell Pub Professional, 2010
2. Fenema owen , Food chemistry. Marcel Dekker publication, 3rd edition, 2005

FBT303	FOOD INDUSTRY WASTE MANAGEMENT			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category :	Major Elective			
			Course Type :	Theory			

Course Objective(s):
Effective utilization of food waste

Course Outcome(s):
CO1: Understand the characterization and physio-chemical property of food waste
CO2: Handle industrial waste with necessary precautions to avoid infection and cross contamination.
CO3: Adapt the available technology in market to utilize food waste as by product
CO4: Monitor the sludge and effluents discharged from food industries meet the limitation by law
CO5: Control environmental pollution by proper treatment of food waste

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M			M									L		
CO2	M					H	H						L		
CO3	M				M		M						L	M	L
CO4				H									L		
CO5	M					M	H						L		

Unit 1: CHARACTERIZATION OF FOOD WASTE 9 Hours
Characterization and utilization of by-products from cereals, pulses, oilseeds, fruits,vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Elements of importance in efficient management of wastes from aforesaid food industries.

Unit 2: 9 Hours
Standards for emission or discharge of environmental pollutants from food processing industries covered under PFA Act., 1986. Characterization of food industries effluents in terms of parameters of importance

Unit 3: 9 Hours
Treatment of food industry effluents Unit concept of treatment of food industry effluents: Screening, sedimentation, floatation as per and primary treatments, biological oxidations: – objectives, organisms, reactions, oxygen requirements, aeration devices.

Unit 4: **9 Hours**

Effect on characteristic parameters of effluents in treatments using lagoons, trickling filters,activated sludge process, oxidation ditches, rotating biological contracters and theirs variations and advanced modifications.

Unit 5: **9 Hours**

Advanced wastewater treatment systems: physical, physicochemical and chemical treatments. Coagulation and flocculation, disinfection, handling and disposal of sludge and treated effluents conforming to EPA provisions.

Text books:

1. Lawrence K. Wang, Yung-Tse Hung., Waste water treatment in the food processing industry, CRC press, 2nd edition, 2006
2. N. F. Gray., Water technology: an introduction for environmental scientists and engineers, Elsevier Butterworth-Heinemann, 2nd Edition, 2002

References:

1. C.S. Rao., Environmental pollution control engineering, Wiley,1991
2. Patwardhan., Industrial Waste Water Treatment, Prentice-Hall of India Pvt Ltd, 1st edition,2008
3. K. C. Agrawal., Environmental pollution and law, Agro Botanical Publishers,1995

FBT309	SUGARCANE TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On Successful completion of course students can be able to

CO1: Explain the preprocessing operation in sugarcane processing

CO2: Identify the extraction operations involved in sugarcane processing

CO3: Use appropriate clarifiers and preservatives to maintain pH and color of juice

CO4: Illustrate the filtration and evaporation involved in cane industry

CO5: State the principle behind the crystallization and production of sugar

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M										M	L	M
CO2	H	M	L									M	H	M	L
CO3	M	M	M	M		H	H					M	H	H	M
CO4	H	M	L									L	M	M	L
CO5	M	L	M									L	M	L	M

Unit 1: PRE-PROCESSING OPERATIONS 9 Hours

Sugarcane - Constituents - Harvesting indices - Cane cutting - Manual, Mechanical - Transportation - loading - Unloading - Cane conveyor - Washing - Shredders - Types.

Unit 2: JUICE EXTRACTION 9 Hours

Crushing - Crushers - Types, crushing efficiency - Extraction of juice - methods, Accumulators - types - Maceration - Theory of cane diffusivity - different diffuser - ring diffuser - weighing of juice.

Unit 3: CANE JUICE CLARIFICATION 9 Hours

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 4: FILTRATION AND EVAPORATION PROCESS IN CANE INDUSTRY 9 Hours

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 5: SUGAR PRODUCTION FROM CANE JUICE 9 Hours

Crystallization - Super saturation - Crystallizers type - batch and continuous. Centrifuge - types. Drying of sugar - conveyors for sugar - by-product from sugar mills - utilization.

Text books:

1. Ram Behari Lal and Mathur. 1972. Hand book of cane sugar technology. Oxford and IBH publishing company New Delhi
2. Earle, R.L. Unit Operations in Food Processing. Pergamon press

Reference books:

1. Baikow, V.E. 1967. Manufacturing and refining of raw cane sugar. Elsevier Publishing Company, New York
2. McCabe, W.L. and J.e. Smith 1976. Unit operations in chemical engineering. McGraw Hill Kogakusha Ltd., Tokyo

FBT310	BEVERAGE TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On Successful completion of course students can be able to

CO1: Classify the different types of beverages

CO2: Select the suitable techniques for production and preservation of fruit juices and concentrates with process equipments

CO3: Recommend appropriate process for production of coffee and tea

CO4: Describe and compare processes employed in the production of different types of wine

CO5: Outline the process line of fermented beverages

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M										H		
CO2	H	L	H	H		H	H					H	H	L	M
CO3	M	M	M									M	H	M	L
CO4	M	M	M									M	H	L	L
CO5	M	M	M									M	H	M	M

Unit 1: INTRODUCTION

Classification, production and consumption of beverages- Alcoholic beverages & non-alcoholic beverages- carbonated and non carbonated.- Concept of fermentation for production of beverages- Raw materials, equipment, quality control and legislation of beverage products.

Unit 2: FRUIT JUICES

Fruit Juices Squashes & Cordials: Equipment for fruit juices, double operations process- Pulping equipment, flash pasteurization, fruit beverage -preparation & preservation- Straining, filtration & clarification - Preservation of fruit juices preservation by addition of sugar, freezing, by carbonation & by filtration.

Unit 3: COFFEE AND TEA PROCESSING

Coffee-Production practice, processing of coffee beans into powder, instant coffee, decaffeination- Tea-Leaf processing, various classes of tea, changes during processing of tea leaves, instant tea,

Unit 4: CHEMISTRY OF FERMENTATION –

composition of wine - mold & yeast of grape & wine- Production of red & white table wine, production of sherry sparkling wine, desert wine vermouth wine, flavored wine, fruit wine etc- Non bacterial & bacterial spoilage of wine- winery by products.

Unit 5: BREWING

Fermented Beverages: Beer –Brewing, raw material & manufacture, storage finishing & packaging- Brandy & whisky production - Definition, compounds & methods for manufacturing

Text books:

1. Varman Alan, and Sakesland, Technology, Chemistry and Microbiology of food beverages, Springer (sie) Publisher, 2nd edition, 2009

Reference books:

1. Girdharilal and Siddappa, Preservation of Fruits and Vegetables, Kalyani Publishers, 2001.
2. W.V.Cruees, Commercial fruits and Vegetable products, Agrobios Publishers, 2009.
3. W.V.Cruees, Technology of wine making food science, Agrobios Publishers, 2009.

FBT311	BAKERY AND CONFECTIONARY TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion students can be able to

CO1: Adapt the standards and regulations followed in Bakery and confectionary industry

CO2: Grasp basic knowledge about Food ingredients and its use in bakery products

CO3: Utilize bakery unit processing machinery effectively

CO4: Handle confectinary products and check quality in process line

CO5: Adapt various process flow line in confectionary and bakery products

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L							L				M		H	
CO2	H											M	M		
CO3	L				H							L			
CO4	L	H		H								M	H	M	
CO5	L											M	M	M	M

Unit 1:

Current status, growth rate, and economic importance of Bakery and Confectionary Industry in India. Product types, nutritional and safety of products, pertinent standards & regulations.

Unit 2:

Bakery Products: Ingredients & processes for breads, biscuits, cookies & crackers, cakes & pastries; doughnuts; rusks; other baked products.

Unit 3:

Equipments used, product quality characteristics, faults and corrective measures for above bakery products. Defining and assessing quality of ingredients & products.

Unit 4:

Confectionary Products: Hard-boiled candies, toffees fruit drops, chocolates and other confectionarys:- ingredients, equipments & processes, product quality parameters, faults and corrective measures.

Unit 5:

Production & quality of chewing and bubble gums, cocoa products, breakfast cereals, macaroni products, sprouted grains.

Text books:

1. Samuel.A.Matz, Bakery Technology and Engineering, Springer Publication US, 1991.
2. Samuel.A.Matz, Cereals as Food and Feed, Springer Publication US,1991
3. Beckette, Industrial Chocolate Manufacture, Wiley-blackwell publisher, 3rd edition, 2009
4. Faridi Faubion, Dough rheology and baked product texture, CBS publications, 1997

Reference books:

1. Minifie. B.W. Chocolate, cocoa and confectionary, Springer publishers, 1989
2. Duncan Manley, Technology Of Biscuits, Crackers And Cookies, Crc publisher, Second Edition,1998
3. Pyler, Baking science and Technology, Sosland Pub Co, 2009

FBT312	METABOLISM AND NUTRITION				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of course, Students can able to

CO1: Understand chemical process involved in the digestion of dietary carbohydrates

CO2: Group amino acids and its importance in food industry

CO3: Classify fatty acids and lipids

CO4: Understand Basic knowledge of DNA and RNA

CO5: Estimate the calories present in a diet

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												L		
CO2	M												L		
CO3	M														
CO4	M	M											L		
CO5		M		M	L	M							L		L

Unit 1:

Chemical process involved in the digestion of dietary carbohydrates and their absorption Glucose as the major sugar in the body – Utilization of Glucose – Oxidation – Glycolysis and Aerobic Oxidation in Citric Acid Cycle – Glycogenesis – Lipogenesis – their cellular and hormonal control – cyclic AMP Ckycogenolysis and Neoglucogenesis. Role of Liver in carbohydrate metabolism. Regulation of blood sugar level Glycosuria. Glucose tolerance test and its importance.

Unit 2:

Functional diversity – composition of proteins – the size of protein molecules – their building blocks – Proteins. Amino acids. Classification of amino acids – R – groups of Amino acids – Non polar. Unchanged polar side chains. Acidic R – groups and basic R – Groups – optical properties of Amino Acide – Acid Base properties of Amino Acids. Zwitter ion and isoelectric pH. D & L forms of Amino acids – optical activity Keto Acids of common Amino acids – Primary amines derived from Amino acids Protein structure – the peptide bond Primary structure – amino – terminal & C terminal Amino acids the effect of amino acid substitution in the primary structure. Rudimentary knowledge of secondary, tertiary and quaternary structure – Protein confirmation Globular proteins and fibrous protein denaturation Simple proteins and conjugated protein. Plasma proteins Immunoglobulins Digestion of proteins and the absorption of Amino acids. Amino acid pool – protein turn over. Removal of Nitrogen from Amino Acids. Transamination – Role of Glutamate – oxidative deamination by Glutamate dehydrogenase. Disposal of ammonia – urea cycle – importance of Glutamine – Catabolism of

the carbon skeleton of amino Acids, Glucogenic and ketogenic amino acids. Catabolism of phenylalanine and Tyrosine to illustrate inborn error of metabolism.

Unit 3:

Criteria for Lipid – classification – fatty acids Short and long chain fatty acids. Saturated fatty acids – Palmitic acid and stearic acid – Monounsaturated fatty and Polyunsaturated fatty acid – Essential fatty acid. Fat or Triglycerides or Triacglycerol – simple and mixed. Melting points Phospholipids Glycerophosphatides – emphipathic properties Sphingomyelins – Cerebrosides their nature. Sterols – Cholesterol and related compounds – Bile acids. Androgens – Estrogens, Progesterone. Cortisol Aldosterone and Vitamin D Digestics and absorption of dietary Lipids. Transport of lipids in serum. Lipoproteins Metabolism of adipose tissue – ß oxidation of fatty acids formation and metabolism of ketone bodies - ketosts, Outline of fatty acids synthesis – Cholesterol metabolism. Absorption, transport, general outline of cholesterol synthesis, its regulation. Excretion of cholesterol – Bile Acids - compounds of biological importance that are formed from cholesterol – Vitamin D and steroid hormones. Serum Cholesterol and its relation to Atheroselerosis.

Unit 4:

Elementary, knowledge of DNA & RNA – Base composition. Nucleosides & Nucleotides – Basics structure of DNA – Different types of RNA. Introduction to the biological tiad, DNA RNA Protein. Genetic Code – Basic reaction leading to protein biosynthesis – Replication – Transcription Translation – Antimetabolites and Antibiotic that inhibit protein biosynthesis, General outline of the synthesis and catabolism of Purines and Pyrimidines in man.

Unit 5:

BMR – specific dynamic action caloric value of foods. Computing caloric requirements balanced diet – carbohydrate factor – fat in the diet. Protein nutrition. Essential Amino Acids. Nitrogen Balance – Quality of protein – Biological value of protein – Protein Malnutrition – Obesity – Vitamins & Minerals requirements

TEXTBOOKS

1. Voet, D and Voet, G., Biochemistry, John Wiley and Sons, Singapore, 3rd Edition, 2001
2. Lehninger‟s, A.L. Nelson., D.L., Cox, M.M., Principles of Biochemistry, Worth Publishers, London,4th Edition, 2000

REFERENCE

1. Stryer, L.Berg., J.M.Tymoezko., J.L., Biochemistry, W.H. Freeman Co., New York, 5th Edition, 2002
2. Zubay, G., Biochemistry, McGraw Hill Publishers, New Delhi, 4th Edition, 1999

FBT313	FOOD PROCESS MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of course, Students can able to

CO1: Develop a process flow line effectively with unit operations

CO2: Develop inventory models for effective inventory control

CO3: Identify factors effecting product development

CO4: Analyze breakeven point and pricing strategies

CO5: Adapt and follow regulations for trade

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H											L	M
CO2	L		H											L	M
CO3	L	H		H											
CO4	L	H									M				
CO5	L													H	

Unit 1: PRODUCTION AND INVENTORY MANAGEMENT

Introduction to food industry management-Nature of processing industry - production planning - batch and continuous production. Process planning - definition and concepts. Inventory control - classification, economic ordering, inventory models, ABC analysis.

Unit 2: PRODUCT DEVELOPMENT

Introduction to new product design - factors affecting product development - procedures - product classification - standardization of procedures - pricing strategies - cost oriented, competition oriented.

Unit 3: FINANCIAL MANAGEMENT

Assessing, acquiring and allocating funds - cash flow statement - balance sheet - financial ratio - break even analysis - concept, application in food industry - project appraisal.

Unit 4: MARKET MANAGEMENT

Concepts - consumer market, business market, marketing environment - market segmentation - market measurement and forecasting - advertisement - publicity - market information system - market research - management of distribution channel. Consumer buying behavior - factors influencing consumer buying behavior.

Unit 5: TRADE AND EXPORT

Export, Trade - Government regulations, GATT, WTO regulation. Trade Act regulation relating to maintain hygienic conditions. GATT and world trade organization regulations. Pattent.

Text books:

1. Philip Kotler. 1985. Marketing management, Prentice Hall of India
2. Brigham, Eugene, F. 1989. Fundamentals of financial management, The dryden press
3. Jones, J. 1992. Food Safety. Eagen Press, St. Paul Minnesota

Reference books:

1. Sherilaker. 1985. Marketting management. Himalaya Publishing Company
2. Metha, P.L. 1999. Managerical Economics - Analysis, Problems and cases, Sultan Chand and Sons, New Delhi

FBT314	FOOD PROCESS MODELING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of course, Students can able to

CO1: Develop heat and mass transfer model

CO2: Develop thermal process model of cooling and freezing

CO3: Process food into complex shapes

CO4: Understand processing of foods and its importance

CO5: Identify food quality and Microbial safety

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H										M		M
CO2	L		H										M		M
CO3	L		H										M		M
CO4	L					H									
CO5				H		M									

Unit 1:

The principles of Modelling, kinetic Modelling, the Modelling of heat and mass transfer; diffusion equation

Unit 2:

Navier-stokes equations, heat and mass transfer in porous media Luikov‟s equation. Modelling thermal processes: cooling and freezing

Unit 3:

Introduction Modelling product heat load during cooling & freezing. Modelling foods with complex shapes, numerical solution of the heat conduction equation with phase change.

Unit 4:

Modelling thermal processes: heating, introduction, processing of packed and solid foods, continuous heating and cooling processes.

Unit 5:

Modeling food quality and microbiological safety.

Text books:

1. Ramirez, W., Computational Methods in Process Simulation, Butterworth Publishers, London, 1989
2. Rice, Applied Mathematics for Chemical Engineer, John Wiley and Sons, New York, 1994
3. Edgar, T.F, Himmelblau, D.M., Optimization of Chemical Processes, McGraw Hill, Singapore, 1989

Reference books:

1. Myers, A.L, Seider, W.D., Introduction to Chemical Engineering and Computer Calculations, Prentice Hall, EnglewoodCliffs, New Jersey, 1976
2. Chemical Engineering Refresher Series on "Process Dynamics", McGraw Hill, Singapore, 1983

FBT315	CEREALS, PULSES & OILSEED PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of course, Students can able to

CO1: Understand the structure and composition of common cereals, pulses and oilseeds.

CO2: Identify factors affecting quality parameters in wheat flour

CO3: Adapt Rice milling technology and its effect on quality characteristics

CO4: Process value-added products from barley, oats, sorghum and millets

CO5: Develop low-cost protein foods

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2	L	H		H											
CO3	L													H	H
CO4	L				H									H	H
CO5	L		H		H										

Unit 1:

General introduction and production and utilization trends; Structure and composition of common cereals, pulses and oilseeds.

Unit 2:

Wheat: Types and physicochemical characteristics; wheat milling - products and byproducts; factors affecting quality parameters; physical, chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents; manufacture of bakery products, pasta products and various processed cereal-based foods; manufacture of whole wheat atta, blended flour and fortified flour.

Unit 3:

Rice: Classification, physicochemical characteristics; cooking quality; rice milling technology; by- products of rice milling and their utilization; Parboiling of rice- technology and effect on quality characteristics; aging of rice - quality changes; processed products based on rice.

Unit 4:

Corn: Types and nutritive value; dry and wet milling, manufacture of value-added products; processing of barley, oats, sorghum and millets.

Unit 5:

Legumes and oilseeds: composition, anti-nutritional factors, processing and storage; processing for production of edible oil, meal, flour, protein concentrates and isolates; extrusion cooking technology; snack foods; development of low cost protein foods.

Reference books:

1. Norman, N. Potter & Joseph, H. Hotchkiss., Food Science., An Aspen Publishers., 5th edition., 1995.
2. Samuel, A. Matz., Bakery Technology & Engineering., Copyright by 1992., 3rd edition., 1992.
3. Karel Kulp & Joseph, G. Ponte, Jr., Handbook of Cereal Science & Technology., CRC Press., 2nd edition., 2000.

FBT316	LIPID SCIENCE				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of course, Students can able to

CO1: Understand the aspects of food lipids

CO2: Measure the degradation of lipids during processing

CO3: check stability and shelf life

CO4: Formulate bakery-based shortenings

CO5: Understand the property of emulsion and its application in industry

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2		H		H											
CO3				H		M								M	M
CO4			H			M								M	M
CO5				H										M	

Unit 1:

Nutritional aspects of food lipids and their sources– omega-3 and omega-6 fatty acids and their significance, Phytosterols and their nutraceutical significance.

Unit 2:

Measurement of lipid degradation parameters during deep-fat frying and storage of foods. Flavour emulsions and their stability.

Unit 3:

Fat powders like cream, butter, cod-liver oil etc. and techniques involved such as micro encapsulation, Fat substitutes based on carbohydrates and proteins.

Unit 4:

Formulation and characterization of low-fat spreads, whipped creams, margarines, mayonnaise, salad dressings etc. Bakery shortenings chemistry, formulation and technology.

Unit 5:

Trans-fatty acids- formation during processing and nutritional aspects, Enzymatic approach to tailor made fats

Text books:

1. Casimir, C. Akoh & David, B.Min., Food Lipids : Chemistry, Nutrition and Biotechnology, CRC Press, 2008.
2. Frank D. Gunstone, (Editor), Lipid Synthesis and Manufacture, CRC Press, 1998.

Reference books:

1. Zdzislaw E. Sikorski and Anna Kolakowska, (Editors), Chemical and Functional Properties of Food lipids, CRC Press, 2002.
2. Frank D. Gunstone and Fred B. Padley, Lipid Technologies and Applications, CRC Press, 1997.

FBT317	PROTEIN CHEMISTRY AND TECHNOLOGY			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category :	Major Elective			
			Course Type :	Theory			

Course outcomes:

On successful completion of course, Students can able to

CO1: Analyze the protein quality and quantity in food

CO2: Identify Functional properties of protein and its application in food sector

CO3: Identify interaction of protein with lipids and polysaccharides

CO4: Isolate protein from sources like fish,legumes,oilseeds and microbes

CO5: modify proteins with enzymic,chemical and Physical methods.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H		M		L									
CO2				M	M										
CO3				H	M										
CO4			H		M									M	
CO5			H											M	

Unit 1:

Protein structure and chemistry; protein –protein interactions, methods of evaluation of protein quality and amount, Conventional and novel sources of protein. Functional properties of proteins and their applications; Structure-function relationships of different food proteins, textured vegetable proteins and different methods of texturization.

Unit 2:

Production of proteins, protein concentrates/isolates from legumes, oilseeds, fish, seafood, leaf, microbes High protein food formulations, Modification of proteins by enzymic (manufacture of protein hydrolysates, their characterization and applications), chemical and physical methods. Interactions of proteins with flavours, polysaccharides, lipids and their technological effects, Protein-based fat substitutes, Protein engineering.

Text books:

1. Navam S. Hettiarachchy, Kenji Sato, Maurice R., (Editiors), Food Proteins and Peptides: Chemistry, Functionality Interactions, and Commercialization, CRC Press, 2011.
2. Navam S. Hettiarachchy, Kenji Sato; Maurice R. Marshall, (Editors) , Bioactive Food Proteins and Peptides: Applications in Human Health, CRC Press, 2010.

Reference books:

1. Radomir Lasztity, The Chemistry of Cereal Proteins, CRC Press, Second Edition1995.
2. Shuryo Nakai and H.Wayne Modler, (Editors), Food Proteins: Processing Applications, John Wiley & Sons, 1999.

FBT402	PUBLIC HEALTH ENGINEERING			L	T	P	C
				3	0	0	3
Pre-Requisite	: NIL	Course Category	:	Major Elective			
		Course Type	:	Theory			

Course Outcomes:

On successful completion of the course, students can be

CO1: Inspect purity of water used in industry and its sanitation

CO2: Understand the physical and chemical property of water

CO3: understand the properties of water and its source

CO4: adapt different treatment methods for water

CO5: control quality standards in water

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	H		H		H	H								
CO2	H					H	H								
CO3	H					H	H								
CO4		M		M		H	H							H	L
CO5						H	H								

Unit 1:

Introductory -social and engineering challenge-Sources of Water Supply - Purification of Water - Transmission and Distribution- Industrial uses of water -water supply and its sanitation

Unit 2:

Sources of water: Rain Water - Surface Water - Ground Water- Per capita demand: Domestic Demand, - Industrial Uses - Public Uses - Losses and Waste -Fire Demand, -water quality control and its standards

Unit 3:

Introduction-water quality criteria-domestic water supply- Standards for physical and chemical quality of water; - Physical and chemical standards; -Industrial water standards- boiler feed waters

Unit 4:

Properties of water- standards for quality of treated water; -water treatment plant-an introduction- location of treatment plants; quality of raw water: (a) Preliminary, (b) Turbidity, Suspended Solids and Colour, Meaning and Difference in Expressions (c) Organic Matter

Unit 5:

Iron and manganese removal, -desalination of saline waters-fluoridation and defluoridation-red water problem, -phosphate pollutions, -nitrates and nitrites pollution, treatment methods for removal of nitrates - softening and demineralisation of water:

Text books:

1. Er.G.S.Bajwa, Public health engineering, Deep publishers, Rock House,Chaura Maiden, Shimla Revised Edition.
2. Asit K, Systems Approach to Water management, Mc Graw Hill, New York ,1976.

Reference books:

1. Harold E Babbat, James J Donald, Guidelines for Environmental Monitoring of Water resources Projects, CWC Water supply engineering.

FBT403	OILS AND FATS PROCESSING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course Outcomes:

On successful completion of the course, students can be able to

CO1: Utilize the different methods of oil extraction for edible purpose

CO2: Check the physical and chemical property oils and fats

CO3: Setup process flow line for oil extraction

CO4: Utilization of different sources of oil for blending, stabilization and value addition

CO5: Control quality standards in oil processing.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	H	L	M										H	M
CO2	L	M												H	
CO3	L		H										H		
CO4	L					L									
CO5	L			H											

Unit 1:

Sources; chemical composition; physical and chemical characteristics; functional and nutritional importance of dietary oils and fats. Post-harvest handling storage and processing of oilseeds for directs use and consumption, importance of oil seeds processing in India.

Unit 2:

Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maze germ, etc.

Unit 3:

Degumming, refining, bleaching, hydrogenation, fractional crystalization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering Clarification, neutralization (alkali refining), bleaching, deodorization techniques / processes. Blending of oils. Chemical adjuncts-lecithins, monoglycerides and derivatives, propylene glycol esters, polyglycoesters.

Unit 4:

Hydrogenation, fractionation, winterzation, inter-esterification etc. for obtaining tailor-made fats and oils.

Unit 5:

Production of butter oil, lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Speciality fats and designer lipids for nutrition and dietetics, especially by biotechnology. Mayonnaise and salad dressings. Confectionery coatings. Immitation dairy products - peanut butter and vegetable ghee. Packing and storage of fats and oils, cocoa butter, fat substitutes.

Text books:

1. Bailey, Industrial Oil and Fat Products, John Wiley and Sons. 6th edition 2005

Reference books:

1. Hamilton , R.J and Bharti, A. Fats and Oils: Chemistry and Technology, Applied science, London. 1980, Academic Press, Elesiver applied science London, 1987
2. Salunkhe, O.K Chavan, J.K Adsule, R.N and Kadam, S.S , World Oil seeds: Chemistry , Technology and Utilization. VNR, New York 1992.

FBT404	EGG, POULTRY, MEAT AND FISH PROCESSING TECHNOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On Successful completion, students will be able to

CO1: Describe the production status and nutritional value of egg, poulty meat and fish products

CO2: Explore different methods of processing of eggs

CO3: Summarize the handling and processing of poultry

CO4: Outline the methods of meat processing, quality evaluation and by-product utilization

CO5: Represent the fish and marine products processing and preservation techniques

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1													L		
CO2	H	M		L		L		L				M	H	M	M
CO3	M		H		M	M	L	L				M	H	H	H
CO4	H	M	H		M	M	L	H				M	M	M	M
CO5	H	M	M			M	M	H				H	H	H	H

Unit 1:

Current levels of production, consumption and export of category products. Nutritional, Safety/health and hygienic considerations.

Unit 2:

Egg: Structure, composition, nutritional and functional characteristics of eggs. Grading, spoilage, storage and transportation of whole eggs. Processing of eggs for liquid products (White, yolk and whole egg) and solid products (albumin, whole egg powder) for preservation through freezing & drying.

Unit 3:

Poultry: Pre-slaughter care and consideration; Operations in preparation of dressed poultry, its storage and marketing; Quality and safety considerations; utilization of by-products.

Poultry cuts. Structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality

Unit 4:

Meat: Sources of meat and meat products in India, its importance in national economy. Chemical composition and microscopic structure of meat. Effect of feed, breed and management on meat production and quality. Slaughtering of animals and poultry, inspection and grading of meat. Factors affecting post-mortem changes, properties and shelf-life of meat. Meat quality evaluation. Mechanical deboning, meat tenderization. Aging, pickling and smoking of meat. Meat plant sanitation and safety, Byproduct utilization. Recent trends in meat processing. Ante-mortem examination of meat animals, scientific techniques of slaughtering,

dressing, post-portem inspection, storage, tenderization, cuts, packaging; beef, mutton, pork as human foods, cured meat products, sausages, by-products, frozen and canned meat products

Unit 5:

Fish: Types, catch, examination; care in handling & transportation; processing of shell-fish, crabs, oysters, lobsters, frog legs etc. for domestic and export markets. Filleting and freezing, smoking, dehydration of fish,canning salting & drying of fish. Fish sauce and protein concentrates.

Text books:

1. Lawrie, R.A Meat Science, Pergamon Press, New York, 1988
2. G.J. Mountney , Poultry Products Technology, International Association of Milk, Food and Environmental sanitarians Des moines.,1989.

Reference books:

1. R.L. Hendricksons, Meat, Poultry and Sea Food Technology, Pergamon Press Ne
2. York 1990 Mc Graw Hill New York, 1976.
3. Parkhurst and Mountney, Poultry, Meat and Egg Production, Chapman and Hall .Inc New York, USA, 1996.

FBT405	FRUITS, VEGETABLES AND PLANTATION PRODUCTS			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category : Major Elective				
			Course Type : Theory				

Course outcomes:

On Successful completion, students can be able to

CO1: Analyze the nutritional aspects in fruit and vegetables

CO2: Provide solution for spoilage of fruit and vegetables while handling and storage.

CO3: Set up new processing flow line for new products with quality standards

CO4: Set quality assurance policy in process flow meeting the standards for effective output

CO5: Set up processing flow line with quality standards for chocolate and spices

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M		M										M	
CO2	M					H								M	
CO3	M		H											M	
CO4	M													H	
CO5	M												M	H	L

Unit 1:

Structural, Compositional and Nutritional aspects of fruits and vegetables. Physiological development: Growth, Maturation, Ripening and Senescence. Post-harvest handling including controlled and modified storage. Techniques of processing and preservation of fruits and vegetables by refrigeration and freezing, canning and bottling, drying and dehydration.

Unit 2:

Technology of fruits and vegetable products: Juices and pulps, Concentrates and powders, Squashes and cordials. Beverage: Still and carbonated. James, Jellies and Marmalades. Preserves, candies and crystallized fruits. Tomato products: Puree, Paste, Ketchup,Sauce and soup. Chutneys, pickles and other products.

Unit 3:

Spices: Composition, Structure and characteristics. Preservation and processing of major and minor spices of India; whole spice, Spice powder, Paste and extracts, Spice oils and oleoresins. Composition, Structure, characteristics & processing of cashew nut and other dry fruits

Unit 4:

Composition, Production and processing of Tealeaves: Black tea, Green tea and Oolong tea. Instant tea. Production and processing of coffee cherries by wet and dry methods to obtain coffee beans, grinding, storage and preparation of brew, Soluble /Instant coffee, Use of chicory in coffee, decaffeinated coffee.

Unit 5:

Production, processing and chemical composition of cocoa beans. Cocoa Processes: Cleaning, roasting, alkalization, cracking and fanning, Nib grinding for cocoa liquor, cocoa butter and cocoa powder. Manufacturing process for chocolate: Ingredients, Mixing, Refining, Conching, Tempering, Moulding etc. to obtain chocolate slabs, chocolate bars. Enrobed and other confectionaryproducts.

Text books:

1. G. Lal, G.S. Siddappa and G.L. Tandon Preservation of fruits & vegetables. & G.L. Tandon B.L. Amla, Food Industry, ICAR, New Delhi, 1986.

Reference books:

1. Bernard. W. Minifie, Chocolate, Cocoa, and confectionery,., 3rd Edition, CBS publishers and Distributors, New Delhi , 1997.
2. R.H.H. Wills, T. H. Lee, D. Graham, W. B. McGlasson and E. G. Hall, An introduction to the physiology and handling of fruits and vegetables, South Wales University Press, Kensington, Australia, 1981.

FBT406	POST-HARVEST, PEST AND DISEASE MANAGEMENT IN FOOD SAFETY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On Successful completion, students can be able to

CO1: Analyze the nutritional aspects in fruit and vegetables

CO2: Provide solution for spoilage of fruit and vegetables while handling and storage.

CO3: Set up new processing flow line for new products with quality standards

CO4: Set quality assurance policy in process flow meeting the standards for effective output

CO5: Set up processing flow line with quality standards for chocolate and spices

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M		M										M	
CO2	M					H								M	
CO3	M		H											M	
CO4	M													H	
CO5	M												M	H	L

Unit 1:

Structural, Compositional and Nutritional aspects of fruits and vegetables. Physiological development: Growth, Maturation, Ripening and Senescence. Post-harvest handling including controlled and modified storage. Techniques of processing and preservation of fruits and vegetables by refrigeration and freezing, canning and bottling, drying and dehydration.

Unit 2:

Technology of fruits and vegetable products: Juices and pulps, Concentrates and powders, Squashes and cordials. Beverage: Still and carbonated. James, Jellies and Marmalades. Preserves, candies and crystallized fruits. Tomato products: Puree, Paste, Ketchup,Sauce and soup. Chutneys, pickles and other products.

Unit 3:

Spices: Composition, Structure and characteristics. Preservation and processing of major and minor spices of India; whole spice, Spice powder, Paste and extracts, Spice oils and oleoresins. Composition, Structure, characteristics & processing of cashew nut and other dry fruits

Unit 4:

Composition, Production and processing of Tealeaves: Black tea, Green tea and Oolong tea. Instant tea. Production and processing of coffee cherries by wet and dry methods to obtain coffee beans, grinding, storage and preparation of brew, Soluble /Instant coffee, Use of chicory in coffee, decaffeinated coffee.

Unit 5:

Production, processing and chemical composition of cocoa beans. Cocoa Processes: Cleaning, roasting, alkalization, cracking and fanning, Nib grinding for cocoa liquor, cocoa butter and cocoa powder. Manufacturing process for chocolate: Ingredients, Mixing, Refining, Conching, Tempering, Moulding etc. to obtain chocolate slabs, chocolate bars. Enrobed and other confectionaryproducts.

Text books:

1. G. Lal, G.S. Siddappa and G.L. Tandon Preservation of fruits & vegetables. & G.L. Tandon B.L. Amla, Food Industry, ICAR, New Delhi, 1986.

Reference books:

1. Bernard. W. Minifie, Chocolate, Cocoa, and confectionery,., 3rd Edition, CBS publishers and Distributors, New Delhi , 1997.
2. R.H.H. Wills, T. H. Lee, D. Graham, W. B. McGlasson and E. G. Hall, An introduction to the physiology and handling of fruits and vegetables, South Wales University Press, Kensington, Australia, 1981.

FBT406	POST-HARVEST, PEST AND DISEASE MANAGEMENT IN FOOD SAFETY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On Successful completion, students can be able to

CO1: Classify fruit and vegetables defects by physical examination

CO2: Provide solution for spoilage of fruit and vegetables while handling and transportation.

CO3: Set up minimal processing flow line to eliminate hazards causing spoilages

CO4: Set quality assurance policy in process flow meeting the standards for effective output

CO5: Demonstrate and teach staffs regarding safety, sanitation and hygiene practices.

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H		H								M		M	L
CO2	L		M			H	M					M		M	
CO3	L		H									M		M	
CO4	L		H									M		M	
CO5	L									H		M			

Unit 1:

Fruit and vegetable production, classification of fruit and vegetables, Structure and cellular components.

Unit 2:

Importance- Post harvest losses, Maturity indices, Mechanical injury-types, storage of fruit and vegetable-methods of storage, Respiration and transpiration, methods to measure respiration, ethylene evolution during storage.

Unit 3:

Post harvest handling and transportation, grading and sorting methods and equipment, washing, blanching, peeling and other preparatory operations.

Unit 4:

Minimal processing concept, Enzymatic browning and its control, processing methods and equipment for fruit and vegetable products, spoilage of fruit and vegetable.

Unit 5:

Principles of food safety and food quality - quality management principles - methods of food quality evaluation - risk analysis - Food safety testing, Quality assurance of food commodities - Indian and International food laws and regulations. Sanitation - need for sanitation - safe handling - cross contamination - cleaning and cleaners - CIP cleaning sanitizers, hygiene and safety rules for building and equipments.

TEXT BOOKS

1. L.R. Verma and V.K. Joshi, (Eds). Post-Harvest Technology of Fruits and vegetables, Indus Publishing company, New Delhi, 2000.
2. Mircea Enachescu Dauthy, "Fruit and Vegetable Processing" FAO Agricultural Services Bulletin No.119, 1995
3. Pantastico, E.C.B., Postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVi Pub. Co, 1975.
4. Birch, G. and Campbell-Platt, G. (Eds.)., Food Safety - the Challenge Ahead. Intercept Ltd., Andover, England., 1993

FBT407	TECHNOLOGY OF EXPANDED AND EXTRUDED FOOD PRODUCTS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of course, students can be able to

CO1: Use Preservative in bakery products with good knowledge in chemical property of preservatives

CO2: Identify the right, machinery based on application

CO3: Inspect raw material for bakery and confectionary products

CO4: Set up process flow for confectionary products

CO5: Calibration of scales and equipments to standardize the output

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H													H	
CO2		H		H	M							H			M
CO3				H											
CO4			H		L							H		M	
CO5				H										M	

Unit 1:

Status of bakery and confectionery industries in India- Raw materials for bakery and confectionery products-Essential and optional. PFA Specification of raw materials.

Unit 2:

Dough rheology - Bread making- methods-process- specification for various types of breads- Biscuit manufacturing process- Cookies- Crackers- Cakes- Buns- preservation of bakery products.

Unit 3:

Weighing Equipment- Manual scale, Automatic weigh, liquid measuring. mixing- blenders, Horizontal and vertical planetary, continuous. Make up equipment- Divider, Rounder, Proofer, moulder. Baking equipment - different oven, slicer.

Unit 4:

Confectionery products- chocolate, fondant, caramels, fudge and toffee. Equipment and process.

Unit 5:

Health and safety- safety rules- safe practices in the work places- sanitation- duties of the sanitation equipments-Code for hygiene condition in bakery and biscuit manufacturing unit.

Text books:

1. The complete Technology book on bakery products, National Institute of Industrial Research (India) Board of Consultants & Engineers, 2007.
2. Chocolate, Cocoa, and confectionery, Bernard. W. Minifie., 3rd Edition, CBS publishers and Distributors, New Delhi, 1997.

Reference books:

1. S C Dubey, Basic Baking, Science and craft, Jwalamukhi Job Press, Bangalore, 1979. Edition, CB

FBT408	FOOD PLANT LAYOUT AND DESIGN			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category :	Major Elective			
			Course Type :	Theory			

Course Outcomes:

On successful completion of course, students can be able to

CO1: Design a layout for Food processing plant

CO2: Identify the right, machinery based on application

CO3: Choose the Composition of material used for machine design meeting the requirements

CO4: Set up machinery in process flow meeting the standards and effective output

CO5: Cost estimate and design plant layouts for different food sectors effectively

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		H											M	
CO2	L			H										M	
CO3	L			H											
CO4	L		H											M	
CO5	L		H								M	M		M	

Unit 1: LAYOUT FEATURES

Introduction to plant design - special features of food process industry-types of processing machineries - Manufacturing processes-concept -types-special features for fruit, vegetable, bakery & milk products.

Unit 2: PLANT LOCATION

Plant location, location theory and models-plant site selection-estimation of series- peak and critical load -Economic plant size-plant layout objectives-classical and practical layout.

Unit 3: PRESENTATION OF THE LAYOUT

Development and presentation of the layout-preparation of machinery layout for fruit, vegetables and meat-size reduction machinery layout-size reducing mills-types of machinery for separation of products by size shape and colour.

Unit 4: EVAPORATION AND DRYING PLANT LAYOUT

Evaporation plant layout-single, multiple, vacuum and film evaporators-types and concepts, drying plant layoutdrying process, drier types, selection of driers.

Unit 5: PROCESSING PLANT LAYOUT

Bake oven and frying plant-types, concepts and layout . Filling closing and labeling plant layout. Organization and trends in plant layout - sample layout, installation procedure for food processing plant.

Text books:

1. James, M.More, Plant Layout and Design. Mac Millian Publishing Co., New York 1976.
2. Slade, F.H, Food processing Plants, Leonardhill Books, London, 1967

Reference books:

1. Fundamentals, ASHRAE. American Society of Heating, Refrigerating and Air Conditioning Engineers, ASHRAE Hand book, Atlanta, Georgia, 1981
2. Hall, H. S and Y.Rosen, Milk plant layout, F.A.O.Publication, 1976.

FBT409	MILLING TECHNOLOGY FOR FOOD MATERIALS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course Outcomes:

On successful completion of course, Students can be able to

CO1: Discuss the post-harvest processing methods of cereals and legumes.

CO2: Describe the wheat milling process, flour quality measures

CO3: Illustrate the methods of processing of paddy grain and by-product utilization

CO4: Classify composition and processing of millets and other cereal grains

CO5: Explain the composition of legumes and its processing techniques

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H					M						L	H	M	
CO2	H	M				H	M					M	L	M	L
CO3	H	M				M	M					M	L	M	L
CO4	M		L			M						L	H		M
CO5	M		L			L							H		M

Unit 1:

Importance of cereals and legumes, Post-harvest quality and quantity losses. Recommended pre-processing practices for handling of cereals and pulses for their safe storage, including control of infestation, National and International quality and grading standards.

Unit 2:

Structure, types, composition, quality characteristics and physicochemical properties of wheat. Cleaning, tempering and conditioning, and milling processes for different wheat's. Turbogriding & Air Classification. Blending of flours. Milling equipments and milling products (Dalia, Atta, Semolina and flour). Flour grades and their suitability for baked goods. Quality characteristics and rheological properties of wheat milling products and its assessment. Byproduct utilization.

Unit 3:

Structure, types, composition, quality characteristics and physicochemical properties of rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria in and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice.
Processed rice products (flaked, expanded and puffed rice). By-product (husk and rice bran) utilization.

Unit 4:

Structure, types and composition of corn. Dry and wet milling of corn. Starch and its conversion products. Processed corn products (popped corn, corn flakes etc.) Structure and composition of barley, bajra, jowar and other cereal grains and millets. Malting of barley. Pearling of millets. Parched and snack products.

Unit 5:

Structure, composition and properties of legumes. Cleaning, grading, pretreatments for difficult-to-mill (urad, arhar, moong, moth) and easy-to-mill (chana, masoor and pea) legumes,milling practices and actual milling of different legumes. Sweet and savory products from legumes in India.

Text books:

1. Samuel A.Matz, Cereals technology, CBS publications Springer US 1991
2. N.L.Kent, Technology of Cereals, Wood Head Publishing, 4th edition2004.
3. Shankuntala N.Mannay, Food Facts and Principles , New age International (p) Ltd, 2008

Reference books:

1. Norman N.Potter , Food science, Springer publication, 1995
2. Manual on Rice and its Processing by CFDRI
3. DAV Dendy and B.J.Dobraszerk, Cereals and cereals Products - Chemistry and Technology, Aspen Publication 2001.

FBT410	ENGINEERED, TEXTURISED AND FABRICATED FOODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On Successful completion of course, students can be able to

CO1: Explain the principles of extruder and processing techniques for extruded foods

CO2: Outline the process flow line for various extruded products

CO3: Represent the processing of bevarges, backery products and designer foods

CO4: Indicate the formulation and nutritional value of weaning food, therapeutic foods and geriatric foods

CO5: Illustrate the processing technology of pasta, noodles and vermiciili production

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L										H	M	M
CO2	M		M									M	H	M	M
CO3	M		M									M	H	M	H
CO4	M		L	M		M						M	H	L	M
CO5	M		M									M	H	L	H

Unit 1:

Extruders. Single Screw & Multiple Screw Extruders. Extrusion process. Extrusion cooking. Physical & Chemical Changes during Extrusion Process.

Unit 2:

Textured vegetable protein products. Puffing Gun, Puffed Products. Meat Analogues., Imitation Paneer.

Unit 3:

Fabricated RTS Beverages, Bakery Products, Margarine, Peanut Butter, Imitation Milks Designer Lipids etc.

Unit 4:

Weaning Foods/ Baby Foods. Therapeutic Foods. Geriatric Foods.

Unit 5:

Technology and manufacture of Macaroni, Pasta, Noodles, Vermicilli etc.

Text books:

1. Audrey H. Ensminger, Food and Nutrtion Encyclopaedia, Vol I, CRC Press,
2. Wilson G. Pond, L. Nichols, (Editors), Adequate Food for All: Culture, Science, and Technology of Food in the 21st Century, CRC Press, 2009.

References:

1. Robert E. C. Wildman, Denis M. Medeiros, Advanced Human Nutrition, CRC Press, 1999.
2. Jyoti Prakash Tamang, Kasipathy Kailasapathy, Feremented Foods and Beverages of the World, CRC Press, 2010.
3. Morris Boris Jacobs, The Chemistry and technology of food and food products, Interscience, 1959.

FBT411	FOOD QUALITY AND FOOD LAWS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Major Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO 1: Analyze and interpret sensory evaluation of food product developed

CO2: Manage quality of Food in Process flow line

CO3: Measure and test Food Quality based on physical parameters like volume, density and mass

CO4: Do assessment in nutritional values after processing to recommend intake limit

CO5: Maintain Standard quality and Food laws in company

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		H		H										M	
CO2		L													
CO3		H		H										H	
CO4				H										H	
CO5			M											H	

Unit 1:

(Ways of describing of Food Quality, Quality control and Quality Assurance functions. Total Quality Control (TQC) and the role of management/ TQM. Statistical quality control. Quality costs., Analysis and Interpretation of sensory scores. Application of sensory evaluation in Quality Management offoods.

Unit 2:

Instrumental measurements of sensory attribute of foods: Appearance, color, volume, density and specific gravity, Rheological and textural characteristics. Texture profile analysis. Correlation between instrumental and Sensory analysis of food quality attributes.

Unit 3:

Nutritional Quality of foods and its assessments: Food proteins (Digestibility, Biological value, NPU, PER), Modifications of foods constituents due to processing and storage and their nutritional implications.

Unit 4:

Food standards and Specifications: compulsory and voluntary trade and company standards. Consumer, company, In-process and finished product specifications. Relevant Food laws : PFA, FPO, SWMA, MPO, AgMark, and BIS Standards.

Text books:

1. Inteaz Ali, Food Quality assurance: Principles and Practices, CRC Press, 2004
2. J Andres Vasconcellos, Quality Assurance for the food Industry, CRC Press,2004.

Reference books:

1. Lester E. Jeremiah, Freezing effects on Food Quality, Marcel Dekker, Inc, Feb 1996.
2. Y.Pomeranz Food Analysis: Theory and Practice , Springer publishers, 3rd edition 2008.

MINOR ELECTIVES

CHE363	PROCESS ECONOMICS AND PLANT DESIGN FOR ENGINEERS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Estimate capital investment, total product costs, and profitability

CO2: Design plant layout and installation safety

CO3: Synthesize feasible and optimum flow-sheet

CO4: Understand concepts of process design and project management.

CO5: Develop Optimum design of equipments based on economics and process considerations

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L			M							H	M			
CO2	L		H									M		M	
CO3	M		M									M			
CO4	H											M			
CO5	M		H											M	

Unit 1:

Process selection, study of alternative processes, pilot plant, Scale up methods, Flow sheet preparation, sketching techniques, Equipment numbering, Stream designation, Material and energy balances. Design basis, Process selection -Selection of equipment, specification and design of equipment‟s, material of construction, Plant location, Plant layout and installation, Safety, Start up, Shutdown and Operating guidelines.

Unit 2:

Time value of money and equivalence, Interest, cost comparisons by present worth, Annual equivalent cost and capitalized cost methods, Uniform gradient and series. Depreciation, Taxes and Insurances, Nature of depreciation, Methods of determining depreciation, depreciation rates incurrent Indian situation, Types of taxes and insurance‟s, Procedure for cost comparison after taxes.

Unit 3:

Types of cost estimation, capital investment cost, fixed capital cost, working capital cost, start-up costs, process equipment cost estimation, cost index, Equipment costs due to inflation, Battery limit investments, estimation of plant cost, Estimation of total product cost, manufacturing cost, general expenses. Criteria of profitability, Payout period, Return on investment, Present value, Cash flow analysis, Alternative investment analysis, Sensitive analysis in project profitability.

Unit 4:

Nature of optimization, Uni - variable and multivariable systems, Analytical, graphical and incremental methods of solution, LaGrange multiplier method, Linear programming and dynamic programming establishing optimum conditions, Break even chart for production schedule, Optimum production rates in plant operation, Optimum conditions in batch, cyclic and semi cyclic operation, Sensitivity and response analysis.

Unit 5:

Transportation systems, heat exchangers, evaporators, mass transfer equipments and reactors. Determination of height and diameter of different process equipments at conditions of optimum cost .Pinch Technology analysis. Preparation of techno-economic feasibility report.

Text books:

1. Peters M., Timmerhaus K. & Ronald W., Plant Design & Economics for Chemical Engineers, McGraw Hill, 4th Edition, 2008.
2. James R Couper, Process Engg. Economics (Chemical Industries), CRC Press, 2003.

Reference books:

1. Robert Sancier Aries, Robert D. Newton, Chemical Engineering Cost Estimation, McGraw Hill, 2nd Ed, 1955.
2. William D. Baasel, Preliminary Chemical Engineering Plant design, Van Nostrand Reinhold, 2nd Edition, 1990.

CHE364	SIMULATION OF FLOW PATTERNS IN FOOD PROCESS EQUIPMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Understand the important physical phenomena from the problem statement

CO2: Develop model equations for the given system

CO3: Demonstrate the model solving ability for various processes/unit operations

CO4: Demonstrate the ability to use a process simulation

CO5: Compare various numeric technique for CFD

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2	L		H											H	
CO3	L		H	M		M				M				H	
CO4			M	L		M				M				H	
CO5				H										H	

Unit 1:

Modeling, Classification of models; Models based on transport phenomena principles and applications; Population balance models and applications; Empirical models; Model parameters estimation.

Unit 2:

Simulation: Sequential modular, simultaneous modular and equation oriented approaches; Partitioning and tearing; Simulation examples of fluid flow processes; Monte Carlo simulation.

Unit 3:

Conservation equations for mass, momentum and energy; Comparison of various numerical techniques for CFD; Review of finite difference and finite element methods; Solution to discretized algebraic equation; Finite-volume method for diffusion problems

Unit 4:

Finite-volume method for convection and diffusion problems – pressure velocity coupling; Construction of geometry and discreation using Gambit-Fluent‟s manuals; Commercial CFD solvers; Turbulance modeling;

Unit 5:

Implementation of boundary conditions; Introduction to multiphase flow; Customizing commercial CFD solver; Unsteady state simulations

Text books:

1. Luyben W.L., “Process Modelling, Simulation, and Control for Chemical Engineers”, John Wiley, 1990.
2. Hussain Asghar, “Chemical Process Simulation”, Wiley Eastern Ltd., New Delhi,1986

Reference books:

1. M.M. Denn, “Process Modelling”, Wiley, New York, 1990.

CHE365	NOVEL SEPARATION TECHNIQUES				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Grasp knowledge of various chemical engineering separation processes

CO2: Select appropriate separation technique for intended problem

CO3: Analyze the separation system for multi-component mixtures

CO4: Design separation system for the effective solution of intended problem

CO5: Basic knowledge about physical and chemical properties of membranes

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H						M								
CO2		H		H			M					M		H	
CO3		H		M			M							H	
CO4			H				M							M	
CO5	H						M					M			

Unit 1:

Introduction: Separation process in chemical and Biochemical industries, Categorization of separation process, equilibrium and rate governed processes. Introduction to various new separation techniques e.g. Membrane separation, Ion-exchange foam separation, supercritical extraction, liquid membrane, PSA & Freeze drying.

Unit 2:

Membrane based separation technique (MBSTs): Historical background, physical and chemical properties of membranes, Techniques of membrane preparation, membrane characterization, various types of membranes and modules.

Unit 3:

Osmosis and osmotic pressure. Working principle, operation and design of reverse osmosis, ultrafiltration, microfiltration, electrodialysis and pervaporation. Gaseous separation by membranes.

Unit 4:

Ion Exchange: History, basic principle and mechanism of separation, Ion exchange resins, regeneration and exchange capacity. Exchange equilibrium, affinity, selectivity and kinetics of ion exchange. Design of ion exchange systems and their uses in removal of ionic impurities from effluents.

Unit 5:

Introduction to foam separation, micellar separation, supercritical fluid extraction, liquid membrane permeation and chromatographic separation.

Text books:

1. Coulson, J.M, Richardson, J.F., Chemical Engineering, Vol.II, Butterworth Heinemann, London, 4th Edition, 1991.
2. Loeb, C, Lacey, R.E., Industrial Processing with Membranes, Wiley Inter Science, Singapore, 1972

Reference books:

1. King, C.J., "Separation Processes", McGraw-Hill, 1980.
2. Sourirajan, S. and Matsura, T., "Reverse Osmosis and Ultra-filtration – Process Principles" NRC Publication, Ottawa, 1985
3. Porter, M.C., "Handbook of Industrial Membrane Technology" Noyes Publication, new Jersey, 1990
4. Hatton, T.A., Scamehorn, J.F. and Harvell, J.H. "Surfactant Based Separation Processes", Vol. 23, Surfactant Science Series, Marcel Dekker Inc., New York 1989.

CHE359	TRANSPORT PHENOMENON IN FOOD PROCESSING			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective		
			Course Type	:	Theory		

Course outcomes:

On successful completion of this course, students can be able to

CO 1: Understand transport processes.

CO2: Do heat, mass and momentum transfer analysis.

CO3: Analyze industrial problems along with appropriate boundary conditions

CO4: Develop steady and time dependent solutions along with their limitations

CO5: Design heat exchangers based on experiments on conduction, convection and radiation

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H											M			
CO2		H												M	
CO3		H		H											
CO4	M		H										H		
CO5	M		H								M			H	

Unit 1:

Newton's law of viscosity - pressure and temperature dependence of viscosity, theory viscosity of gases (low density), and liquids, convective momentum transport. Shell momentum balance, boundary conditions.

Unit 2:

The Equations of change for isothermal system – Navier stokes equation, use of equations of change to solve steady state flow problems. Comparison of laminar and turbulent flow, time smoothed equations of change for incompressible fluids. The time smoothed velocity profile near a wall, turbulent flow in duct and jets.

Unit 3:

Fourier‟s law of heat conduction, temperature and pressure dependence of thermal conductivity thermal conductivity of gases, liquids, solids and composite solids.

Unit 4:

Shell energy balances, boundary conditions heat conduction with an electrical heat source, nuclear heat, viscous heat source, chemical heat source, composite walls and fines. Forced convection and free convection.

Unit 5:

Fick's law of diffusion, analogy with heat transfer& mass transfer, Transport by molecular motion, shell mass balances, boundary conditions, temperature and pressure dependence of diffusivities, concentration profile for stagnant gas film, a heterogeneous chemical reaction, homogeneous chemical reaction and porous catalyst.

Text books:

1. Bird, R. B., Stewart, A., and Lightfoot, E. N., Transport Phenomena, John Wiley and Sons, Singapore, Revised 2nd Edition, 2007
2. C. J. Geankopolis, Transport Processes in Chemical Operations, 3rd Edition, Prentice Hall of India, New Delhi, 1996

Reference books:

1. Sissom L.E., and Pitts D.R., Elements of Transport Phenomena, McGraw Hill, New York, 1972
2. Brodkey, R. S., and Hershey, H. C., Transport Phenomena - A Unified Approach, Mc Graw Hill, New York, 1988
3. Deen, W. M., Analysis of Transport Phenomena, Oxford University Press, New York, 1998
4. James R.Welty, Charles E.Wicks and Robert E.Wilson, Fundamentals of momentum, heat and mass transfer, John Wiley and sons, Singapore, 4th Edition, 2001.

CHE360	RHEOLOGY & TEXTURE ANALYSIS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Develop mechanical models to visualize behavior of foods

CO2: Determine the sensory characteristics of food

CO3: Study the food microstructure and its properties

CO4: utilize instrumental methods to analyze textural properties of food

CO5: analyze functions of emulsifiers in relation to food structure

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		H												
CO2			H	M								M			
CO3	H			M								M			
CO4				H										H	H
CO5		H		M											M

Unit 1:

Mechanical properties of foods. Mechanical models to visualise behaviour of foods. Basic and applied rheological considerations and their application to foods.

Unit 2:

Food Microstructure and its study by light, Scanning and Transmission Electron microscopy. Implications of micro-structure in determining mechanical and sensory characteristics of foods.

Unit 3:

Requirement of test systems for measuring food texture. Types of texture Instrument and their operating mechanisms, Calibration, Performance of test and measurements of test parameters. Interpretation of test results.

Unit 4:

Textural properties of fruits & vegetables; Dough, Pasta and Baked products; dairy products; Meat; Fat and fat products; and their instrumental Measurements.

Unit 5:

Rheology of chocolate, Textural characteristics of food emulsions, Functions of emulsifiers in relation to food texture, Sensory measurement of food texture and texture profile.

Reference book:

1. J.M. de Man Rheology and Texture in Food quality

CHE361	FOOD PLANT SAFETY AND HAZARD ANALYSIS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Illustrate risk analysis process and test for food safety

CO2: Infer the quality control tools adopted in food industry

CO3: Carry-out the HACCP for food quality assurance

CO4: Explain the food safety issues due to additives, toxic substances and preservatives

CO5: Discuss about food allergy and cleaner production on different food products

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M								H	M	M	H
CO2	L	M	H	H	L								M	M	
CO3	H	H	M	H	L	M						H	M	H	M
CO4	M	H	M	M		H		M				L	H	H	M
CO5	L						M	M				M	M	L	

Unit 1: FOOD SAFETY

Principles of food safety - Historical developments - indicators of risk - risk analysis - risk management - causes of major failure - clothing and personal hygiene - source of contamination -test for food safety.

Unit 2: QUALITY CONTROL AND FOOD LABELING

Introduction to quality control - definition. Aspects of quality - Quality control tools. Quality control chart - Quality factors in food - Nutritional labeling - Specification - Rules and Regulations - need for food plant sanitation -- cleaning and cleaners - Water supply- Good Manufacturing Practice.

Unit 3: HAZARD ANALYSIS - HACCP

HACCP - History definition - preliminary task - principles - hazard analysis - record keeping- HACCP implementation and maintenance. General principle of microbial risk – assessment- hazard determination - HACCP worksheet. Critical Control Point - identification of critical points in the process - Methods by which obstacles can be overcome.

Unit 4: METAL CONTAMINANTS AND ADDITIVES

Metal contaminants- Sources of health hazard of metallic contaminants - Assessment of food safety - General and acute toxicity - Mutagenicity and carcinogenicity. Additives (Intention - direct) - Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

Unit 5: FOOD ALLERGY

Food allergy, food intolerance, contaminants of processed foods, solvent residue, contaminants of smoked foods. Cleaner production is food industry-fruit and vegetable processing, sea food processing, brewing and wine processing.

Text books:

1. Birch, G. and Campbell-Platt, G. (Eds.), Food Safety - the Challenge Ahead. Intercept Ltd., Andover, England, 1993
2. Finley, J., Robinson, S. and Armstrong, D. (Eds.). Food Safety Assessment. American Chemical Society, Washington D.C. , 1992
3. Jones, J. Food Safety. Eagen Press, St. Paul Minnesota, 1992

Reference books:

1. Bhatnagar, D. and Cleveland, T. (Eds.). Molecular Approaches to Improving Food Quality and Safety. Van Nostrand Reinhold, New York, 1992.
2. Hubbert, W. and Hagstad, H. Food Safety & Quality Assurance. Iowa State University Press, Ames, Iowa , 1991
3. Roberts, H. (Ed.). Food Safety. John Wiley & Sons, New York, 1981.

CHE362	POLLUTION CONTROL IN FOOD INDUSTRIES				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Classify by-products from various processing industries
CO2: Illustrate the different industrial standards covered under PFA
CO3: Discuss about the industrial waste treatments
CO4: Explain physio-chemical methods for advanced waste water system
CO5: Relate the various causes for environmental problems

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		M			M	M					M	M	L	L
CO2	M						H					M	M		L
CO3	M						H						M	H	L
CO4	M					M	M						M	H	L
CO5	M	M		M		H	H					M	M	M	M

Unit 1:

Characterization and utilization by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Elements of importance in efficient management of wastes from aforesaid food industries.

UNIT-II

Standards for emission or discharge of environmental pollutants from food processing industries covered under PFA Act., 1986.Characterization of food industries effluents, in terms of parameters of importance.

UNIT-III

Screening, sedimentation, floatation as per and primary treatments, biological oxidations:– objectives, organisms, reactions, oxygen requirements, aeration devices.

UNIT-IV

Effect on characteristic parameters of effluents in treatments using lagoons, trickling filters, activated sludge process, oxidation ditches, rotating biological contractors and theirs variations and advanced modifications. Advanced wastewater treatment systems: physical, physicochemical and chemical treatments. Coagulation and flocculation, disinfection, handling and disposal of sludge and treated effluents Conforming to EPA provisions.

UNIT-V

Environmental ethics - issues and possible solutions - population explosion, climatic change, ozone layer depletion, global warming, acid rain and green house effect. Sustainable development: definition, objectives and environmental dimensions of sustainable development - environmental audit for sustainable development.

TEXT BOOKS:

1. Green J H, Kramer A, Food processing waste management AVI Publishers, West port, CT, 1979.
2. Vasso Oreopoulou, Winfried Russ, (Eds.), Utilization of by-products and treatment of waste in the food industry, Springer, 2007.

REFERENCES:

1. N F Gray, Water technology: An introduction for Scientists, Elsevier, 2005.
2. K C Agarwal, Environmentalpollution, Vedams Books, 2001.

CHE314	COLLOIDS AND SURFACE SCIENCE				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Understand the basic principles of colloidal stability and self-assembly

CO2: Familiarize with most common instruments used in colloidal sciences and their theories

CO3: Characterize and particulate in terms of their physical properties

CO4: Perform basic calculation and analysis of typical particulate processes, such as size reduction, mixing, enlargement, storage and transport powders

CO5: Describe the most important and fundamental theories in surface chemistry

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H											H			
CO2	H											H			
CO3	M	L		H	H										H
CO4	M	H			H										H
CO5	H											H			

Unit 1: INTRODUCTION

Hamaker's analysis for interparticle attractive forces, Experiments verifying van der Waals interactions between surfaces, Lifshitz macroscopic theory for the Hamaker constant, Parsegian, Ninham's approximation to Lifshitz theory, Casimir and Polder's correction for relaxation effects, Example calculations of Hamaker constants for several specific metal, polymer, and ceramic systems, the influence of other types of interparticle forces

Unit 2: HIERARCHY OF SURFACE CHEMICAL MODELS

The hierarchy of surface chemical models for surface charging – Monoprotic surface charging systems Lattices and Organic acids, Metallic and Non,oxide Systems - The role of surface oxygen in dictating surface charge for metal and non-oxide ceramic systems

Unit 3: ELECTRIC DOUBLE LAYER

The isolated electric double layer - Overlap of the double layer for interacting particles, free NRGs of isolated and interacting double layers, Repulsive NRG due to overlapping double layers - Derjaguin approximation for the interaction of spherical particles - Concept of the critical coagulation concentration, Influence of salt concentration, ionic strength, and ionic size - Influence of surface charge for monoprotic surface charge systems - The role of surface charging in the dispersion of solids in non-aqueous systems

Unit 4: STABILIZATION OF PARTICLES WITH NON- IONIC POLYMERS

Criteria for stabilization of particles with non-ionic polymers - The role of polymer solubility in stabilization -The role of co, and ter, polymers in providing stabilization reconciling surface attachment with polymer extension from the surface, the impenetrable barrier model for polymeric stabilization - The compression model by Bagchi for polymeric dispersion, the interpenetration and compression model for polymeric dispersion, Other assumptions with respect to the relative contribution of the Hamaker constant toward stabilization with polymers - Selection criteria for polymeric dispersants for specific types of material systems, Polymeric dispersion of nanometer size particles

Unit 5: FEATURES OF POLYELECTROLYTE

Features of polyelectrolyte that contribute to their dispersing power - pKa, molecular size and distribution, type of polymer - Criteria for polyelectrolyte adsorption to charged surfaces - The role of pKa - Monitoring adsorption via solution depletion, EM scattering, and zeta potential measurements, polyelectrolyte conformation at charged surfaces - The combined electrostatic and impenetrable barrier model for dispersion of particles with polyelectrolytes - Some other concepts regarding "nonionic" dispersants in aqueous systems, interaction of polyelectrolytes with ionic species in solution

Text books:

1. Hiemenz, P.C, Raj Rajagopalan., Principles of Colloids and Surface Chemistry, Marcel Dekker, New York, 1997
2. De Keizer, Johannes Lyklema, Hans Lyklema., Fundamentals of Interface and Colloid Science, Elsevier, New Delhi, 1995

Reference books:

1. Milling, A.J., Surface Characterization Methods Principles, Techniques and Applications, (Surfactant Science Series- V, 87), CRC, New York 1999

CHE323	MEMBRANE SCIENCE AND TECHNOLOGY			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category :	Minor Elective			
			Course Type :	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Understand various membrane separation processes such as gas permeation, reverse osmosis, microfiltration, electrodialysis, membrane reactor, etc.

CO2: Understand how the industrial membranes are prepared

CO3: Select membrane for progessinf and design component

CO4: Calculatate of membrane permeability parameters

CO5: Design membrane modules and its systems for reverse osmosis, gas separation, membrane contactors and organic solvent nanofiltration

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H					L	M					H		M	
CO2	H					L									
CO3	M		H											M	
CO4	M	H												M	L
CO5			H			L	H						H	M	L

Unit 1: MEMBRANES

Membranes - Types, membrane process, membrane transport theory, solution diffusion model - Structure, permeability relationships, pore, flow membranes

Unit 2: LIQUID MEMBRANES

Membranes and modules, isotropic membranes, anisotropic membranes, metal membranes and ceramic membranes, liquid membranes, hollow fibre membranes, membrane modules

Unit 3: CONCENTRATION POLARIZATION

Concentration polarization - Liquid separation process, gas separation process, cross flow, co-flow and counter flow - Reverse osmosis, theoretical background, membrane selectivity, module, fouling

Unit 4: ULTRACENTRIFUGATION

Ultracentrifugation membranes - Characterization of ultra-filtration membranes - Modules, System design - Micro filtration, background and applications - Pervaporation, membrane materials, process design -Ion exchange membrane, chemistry of ion exchange membranes, transport in electro dialysis membrane, system design

Unit 5: MEDICAL APPLICATIONS

Medical Applications - Haemodialysis - Blood oxygenators, control drug delivery, membrane processes dialysis - Donan dialysis and diffusion dialysis - Charge mosaic membranes and piezo dialysis, membrane contractors and membrane distillation, membrane reactors

Text books:

1. Baker, R.W., Membrane Technology and Applications, Wiley Interscience, Singapore, 2nd Edition, 2004
2. Strathmann, H., Ion, Exchange Membrane Separation Processes, Volume 9, Elsevier Science, New Delhi, 2004

Reference books:

1. Vieth, W.R., Membrane Systems Analysis and Design Applications in Biotechnology, Biomedicine and Polymer Science, Wiley Interscience, Singapore, 1994
2. Timashev, S.F, Kemp T.J., Physical Chemistry of Membrane Process, Prentice Hall, New Jersey,1991
3. Marcel Mulder., Basic Principles of Membrane Technology, Kluwer Academic Publishers, New York, 1996

CHE410	FINITE ELEMENT METHODS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Minor Elective			
			Course Type	:	Theory			

Course outcomes:

On successful completion of this course, students can be able to

CO1: Students have basic understanding of the principles and concepts related to finite element methods

CO2: Implement Finite element analysis of bending beam

CO3: Finite element analysis of 2D elements calculations

CO4: Validate a Finite Element model using a range of techniques and communicate effectively

CO5: Implement Finite element analysis of 2-D problems – applications in plane stress/plane strain

Mapping of COs and POs:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H											H			
CO2			M											H	
CO3		H												H	
CO4			H							M				H	
CO5	H	L	L											H	

Unit 1: STRUCTURAL ANALYSIS

Review of various approximate methods in structural analysis - Stiffness and flexibility matrices for simple cases - Basic concepts of finite element method - Formulation of governing equations and convergence criteria

Unit 2: BAR AND BEAM ELEMENTS IN STRUCTURAL ANALYSIS

Use of bar and beam elements in structural analysis – Computer implementation of procedure for these elements

Unit 3: 2-D ELEMENTS

Different forms of 2-D elements and their applications for plane stress, plane strain and axisymmetric problems - Consistent and lumped formulation - Use of local coordinates - Numerical integration

Unit 4: 3-D ELEMENTS

Definition and use of different forms of 2 D and 3 D element - Computer implementation of formulation of these elements for the analysis of chemical process equipments

Unit 5: SIMULTANEOUS EQUATIONS

Different methods of solution of simultaneous equations governing static, dynamics and stability problems - General purpose Software packages

Text books:

1. Cook, Robert D., Concepts and Applications of Finite Element Analysis, Wiley, Singapore, 4th Edition, 2001
2. Zienkiewicz, O.C., The Finite Element Method Its Basis and Fundamentals, Butterworth- Heinemann, London, 6th Edition, 2005

Reference books:

1. Segerlind, L.J., Applied Finite Element Analysis, John Wiley and Sons, New York, 2nd Edition, 1984
2. Bathe, K.J, Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India Ltd, New Jersey, 1983
3. Krishnamurthy, C.S., Finite Elements Analysis, Tata McGraw Hill, New Delhi, 1987.

HUMANITIES ELECTIVES

HSS001	TOTAL QUALITY MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course outcomes:

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

CO1: Explain the role and nature of quality in evolving international economic conditions

CO2: Describe the quality encounter process, including supporting facilities and customer requirements/characteristics

CO3: Classify quality measurement methods and continuous improvement process

CO4: Discuss Quality Management strategy methods, including identification, development, implementation and feedback processes

CO5: Select quality recovery processes and their role in the marketing process

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H										M				
CO2	H					H						M	H		
CO3	H			H									H		
CO4	H			M										H	
CO5	M			H								M			

Unit 1: INTRODUCTION TO QUALITY MANAGEMENT

Definitions - TOM framework, benefits, awareness and obstacles - Quality - vision, mission and policy statements - Customer Focus - customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality

Unit 2: PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology

Unit 3: STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY

Meaning and significance of statistical process control (SPC) - construction of control charts for variables and attributed - Process capability - meaning, significance and measurement - Six sigma concepts of process capability - Reliability concepts - definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) - principles, applications, reengineering process, benefits and limitations

Unit 4: TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT

Quality functions development (QFD) - Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) - requirements of reliability, failure rate, FMEA stages, design, process and documentation

Unit 5: TAGUCHI TECHNIQUES

Taguchi techniques - introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE

Reference Books:

1. Dale H.Besterfield et al, Total Quality Management, Pearson
2. Education, Thrid edition, (First Indian Reprints 2004)
3. Shridhara Bhat K, Total Quality Management - Text and Cases, Himalaya Publishing House, First Edition, 2002
4. William J.Kolarii, Creating quality, Mcgraw Hill, 1995
5. Poornima M.Charantimath., Total quality management, Pearson Education, First Indian Reprint, 2003

HSS002	ENGINEERING MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: INTRODUCTION

Demand and Revenue Analysis - Demand Forecasting - Production Analysis - Cost and Supply Analysis, Price and output Determination - Investment Analysis - Plant Location - Economic Optimization.

Unit 2: FORMS OF BUSINESS AND FUNCTIONS

Types of Business Organisation, Forms - Planning - Organizing - Designing effective organisations – Coordination

Unit 3: HUMAN RESOURCE DEVELOPMENT

Motivating individuals and workgroups - Leadership for Managerial Effectiveness - Team working and Creativity - Managerial Communication - Personal Management - Time Management - Stores Management - Career Planning.

Unit 4: FINANCIAL MANAGEMENT

Product development - Management techniques in product development - Nature of controlling - Operations Management - Just-in-Time.

Unit 5: GLOBAL ENVIRONMENT

Managing World Economic Change - The global environment - Multinational Strategies - Economic Cycles and Director Investment - Change and Organisation Development - Managerial Ethics and Social responsibilities.

Reference books:

1. Harold Koontzand Heinz Weihrich, Essentials of Management, Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrichand Aryasri, Principles of Management, Tata McGraw Hill publishing company Ltd.
3. Tripathiand Reddy, Principles of Management, Tata McGraw Hill publishing company Ltd.
4. Hampton, Management, Tata McGraw Hill publishing company Ltd.
5. L.M.Prasad, Principles of Management.

HSS004	INDUSTRIAL PSYCHOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course outcomes:

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

CO1: To learn basic concepts of industrial and organisational Psychology

CO2:To illustrate different ways of achieving organisational effectiveness through individual behaviour

CO3:To learn concepts relating to individual behaviour to achieve group target and achieve leadership position in organisation

CO4:To understand the organisational changes and means to evaluate based on nature of organisation

CO5:To learn implications of changes aligning the interest of individual, group and organization as a whole

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H										M				
CO2	H					H						M	H		
CO3	H			H									H		
CO4	H			M										H	
CO5	M			H								M			

Unit 1: INTRODUCTION

The role of the psychologist in industry, the field of occupational Psychology - Study of behaviour in work situation and applications of psychological principles to problems of selection, Placement, Counseling and training

Unit 2: DESIGN OF WORK ENVIRONMENTS

Human engineering and physical environment techniques of job analysis, Social environment-Group dynamics in Industry Personal psychology - Selection, training, placement, promotion, counseling, job motivations, job satisfaction. Special Study of problem of fatigue, boredom and accidents,

Unit 3: UNDERSTANDING CONSUMER BEHAVIOUR

Consumer behaviour; study of consumer preference, effects of advertising, Industrial morale - the nature and scope of engineering psychology, its application to industry

Unit 4: WORK METHODS

Efficiency at work, the concept of efficiency, the work curve, its characteristics - The work methods; hours of work, nature of work, fatigue and boredom, rest pauses. The personal factors; age abilities, interest, job satisfaction The working environment - noise, illumination, atmospheric conditions - Increasing efficiency at work; improving the work methods, Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

Unit 5: WORK AND EQUIPMENT DESIGN

Criteria in evaluation of job-related factor, job design, human factors, Engineering information, input processes, mediation processes, action processes, methods design, work space and its arrangement, human factors in job design. Accident and Safety - The human and economic costs of accidents, accident record and statistics, the causes of accidents situational and individual factors related to accident reduction

Reference books:

1. Tiffin,J and McCormic E.J., Industrial Psychology, Prentice Hall, 6th Edition, 1975.
2. McCormic E.J., Human Factors engineering and design, McGraw Hill, 4th Edition,1976. Mair, N.R.F., Principles of Humanrelations
3. Gilmer, Industrial Psychology
4. Ghiselli and Brown, Personnel and Industrial Psychology.
5. Myer, Industrial Psychology.
6. Dunnete, M.D., Handbook of Industrial and OrganizationalPsychology.
7. Blum and Taylor, Industrial Psychology

HSS005	CONSUMER PSYCHOLOGY				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: CONSUMER BEHAVIOUR

Introduction - Consumer behaviour - concepts - dimensions of consumer behaviours - application of consumer behaviour knowledge in marketing decisions - approaches to the study of consumer behaviour

Unit 2: LEAENING AND DECISION MAKING PROCESS

Motivation, ability and opportunity; exposure, attention and perception Categorizing and comprehending information Attitude formation and change - memory and retrieval Process of decision making - psychographics Consumer behaviour outcomes - consumer welfare

Unit 3: GROUP BEHAVIOUR

Group dynamics and consumer reference groups - Family - Social class cultural and sub-cultural aspects - cross cultural consumer behaviour

Unit 4: INFLUENCER BEHAVIOR

Personal influence and opinion leadership - diffusion of innovations - consumer decision - making process - models of consumer decision process - Nicosia- Howard Sheth and Engel-Kollat model- post purchase behaviour

Unit 5: CONSUMERISM

Consumer protection - difficulties and challenges in predicting consumer behaviour - online consumer behaviour - organizational and industrial buyer behaviour - consumer behaviour in Indian context - emerging issues

Reference books:

1. David L.Loudon, Albert J Della Bitta, Consumer Behaviour, McGraw Hill, New Delhi, 2002.
2. Jay D. Lindquist and M.Joseph sirgy, Shopper, buyer and consumer Behaviour, Theory and Marketing application, Biztantra Publication, New Delhi, 2005.
3. Sheth Mittal, Consumer Behaviour A Managerial Perspective, Thomson Asia (P) Ltd., Singapore, 2003.
4. K.K.Srivastava, Consumer Behaviour in Indian Context, Goal Gotia Publishing Co, New Delhi, 2002.
5. S.L. Gupta and Sumitra Pal, Consumer Behaviour an Indian Perspective, Sultan Chand, New Delhi, 2001.
6. Ms.Raju, Dominique Xavedel, Consumer behaviour, Concepts Applications and Cases, Vikas publishing house (P) Ltd., New Delhi, 2004.

HSS006	PROFESSIONAL ETHICS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course Outcomes:

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

CO1: Understand the engineering code of ethics and be able to apply them as necessary.

CO2: Understand moral complexities in many engineering activities and decision-making processes

CO3: Understand some of the contemporary issues in the engineering professions

CO4: Effectively communicate their knowledge and understanding of engineering ethics

CO5: Students learnt the moral issues and moral problems in engineering and how to find the solution to those problems.

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M								M			H		L	
CO2									H						
CO3	M							H						H	
CO4						L			M	M					
CO5									H	H	M				

Unit 1: ENGINEERING ETHICS

Functions of Being a Manager - Stock holder and stakeholder management - Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues

Unit 2: ENGINEERING AS SOCIAL EXPERIMENTATION

Senses of Ethics - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg‟s theory - Gilligan‟s theory - Consensus and Controversy - Professions and Professionalism - Professional ideals and virtues - Theories about right action - Self-interest - Customs and religion - Use of Ethical Theories

Unit 3: ENGINEER RESPONSIBILTY FOR SAFETY

Corporate social responsibility - Collegiality and loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Discrimination

Unit 4: RESPONSIBILITY AND RIGHTS

Moral imagination, stake holder theory and systems thinking - One approach to management Decision - making Leadership

Unit 5: GLOBAL ISSUES

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Sample code of conduct

Reference books:

1. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996
2. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999
3. Laura Schlesinger, How Could You Do That: The Abdication of Character, Courage, and Conscience, Harper Collins, New York, 1996
4. Stephen Carter, Integrity, Basic Books, New York, 1996
5. Tom Rusk, The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life, Viking, New York, 1993

HSS007	OPERATIONS MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: INTRODUCTION TO PRODUCTION AND OPERATION MANAGEMENT

Production and Operations Management (POM) - Need, History, System, Types, functions and communication in POM

Unit 2: MATERIAL AND INVENTORY MANAGEMENT

Material Management (MM) - Handling Technology (Robots, Automated storage and retrieval systems (ASRS) and methods (JIT, / Kanban, ABC Systems) - Independent Demand Inventory Models - Fixed order system, Basic EOQ, EBQ Models, Quantity discount models
- Dependent Demand Inventory models - MRP and MRP II systems Introduction to ERP, e-business and e-operations strategies

Unit 3: PLANNING AND FORECASTING

Introduction to Strategic, Tactical, Operational, Aggregate and Capacity Planning - Planning Product design and development - Applications of CAD, CAM, Computer Integrated Manufacturing

Unit 4: FORECASTING AND SCHEDULING:

Forecasting - Types, Methods (Qualitative and Quantitative), Types of variation in data, Minimizing forecasting errors and selection of forecasting methods. Johnson‟s Algorithm for job sequencing (n job thro‟ 2 machines, n jobs thro‟ 3 machines, n jobs thro‟ m machines and 2 jobs thro‟ m machines) Use of Gantt charts, Queuing analysis and Critical Ratios as methods for job scheduling

Unit 5: FACILITY, LAYOUT LOCATION AND WORK MEASUREMENT

Facility Location Decisions (FLcD) - Facility Layout Decision (FlyD) - Types (Fixed Position, and Production, Process, Flexible), Methodologies (Distance Minimising, Computer software systems (CRAFT, CORELAP, ALDEP), Line Balancing and performance ratios, work measurement methods (WM) - Time study, methods-time measurement

Reference books:

1. R.Paneer Selvam, Production and Operations Management, Prentice Hall of India, 2002
2. Sang M Lee and Marc J Schniederjans, Operation Management, All India Publishers and Distributors, First Indian edition, 1997
3. Robert H. Lowson, Strategic operations Management (The new competitive advantage), Vikas Publishing House, First Indian reprint, 2003

HSS008	INTRODUCTION TO ECONOMICS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: DEFINITION AND SCOPE OF ECONOMICS

Definitions by A. Smith, A. Marshal and L. Robbins, P.Samuelson and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics

Unit 2: LAW OF DEMAND

Elasticity of demand - price, income and cross, concepts and measurement - Marshallian theory of consumers‟ behaviour and its critical examination - Indifference curve analysis - Price, income and substitution effects - Giffen goods- Engel curve

Unit 3: MARKET STRUCTURE

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly

Unit 4: MACRO-ECONOMICS

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control

Unit 5: COMMERCIAL AND CENTRAL BANKS

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments

Reference books:

1. Ackley, G., Macroeconomics: Theory and Policy, Macmillan Publishing Company, New York, 1978
2. Gupta, S.B., Monetary Economics, S. Chand and Co., New Delhi, 1994
3. Ruddar Datt and K.P.M.Sundharam, Indian Economy, S.Chand and Company Ltd., New Delhi, 2003
4. Kindleberger, C.P., R.D. Irwin, International Economics, Home Wood, 1973.
5. Lewis, M.K. and P.D. Mizan, Monetary Economics, Oxford University Press, New Delhi, 2000
6. Ahuja H.L., Economic Environment of Business, Macroeconomic analysis, S.Chand and Company Ltd., New Delhi, 2005
7. Gupta, G.S. Macroeconomics, Theory and Applications, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001

HSS010	INTERNATIONAL TRADE AND FINANCE				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: INTERNATIONAL TRADE

International Trade - Meaning and Benefits - Basis of International Trade - Foreign Trade and Economic Growth - Balance of Trade - Balance of Payment - Current Trends in India - Barriers to International Trade - WTO - Indian EXIM Policy.

Unit 2: EXPORT AND IMPORT FINANCE

Special need for Finance in International Trade - INCO Terms (FOB, CIF, etc.,) - Payment Terms - Letters of Credit - Pre Shipment and Post Shipment Finance - Forfeiting - Deferred Payment Terms - EXIM Bank - ECGC and its schemes - Import Licensing - Financing methods for import of Capital goods.

Unit 3: FOREX MANAGEMENT

Foreign Exchange Markets - Spot Prices and Forward Prices - Factors influencing Exchange rates - The effects of Exchange rates in Foreign Trade - Tools for hedging against Exchange rate variations - Forward, Futures and Currency options - FEMA - Determination of Foreign Exchange rate and Forecasting.

Unit 4: DOCUMENTATION IN INTERNATIONAL TRADE

Export Trade Documents - Financial Documents - Bill of Exchange- Type- Commercial Documents - Performa, Commercial, Consular, Customs, Legalized Invoice, Certification of Origin Certificate Value, Packing List, Weight Certificate, Certificate of Analysis and Quality, Certificate of Inspection, Health certificate. Transport Documents - Bill of Landing, Airway Bill, Postal Receipt, Multimodal Transport Document. Risk Covering Document: Insurance Policy, Insurance Cover Note. Official Document: Export Declaration Forms, GR Form, PP From, COD Form, Softer Forms, Export Certification, Certification of Origin, GSPS - UPCDC Norms

Unit 5: EXPORT PROMOTION SCHEMES

Government Organizations Promoting Exports - Export Incentives : Duty Exemption - IT Concession - Marketing Assistance - EPCG, DEPB - Advance License - Other efforts I Export Promotion - EPZ - EQU - SEZand Export House.

Reference books:

1. Apte P.G., International Financial Management, Tata McGraw Hill.
2. Larceny and Bhattacharya, International Marketing, Sultan Chand and Sons.
3. B.M.Wali and AB Kalkumdrikas, Export Management, Sterling Publishers Pvt., Ltd.
4. Websites of WTO, World Bank, IMF, Ministry of Commerce, ECGC and EXIM Bank.

HSS011	INFORMATION SYSTEMS FOR MANAGERIAL DECISION MAKING				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: INTRODUCTION

Information system - establishing the framework - business model - information system architecture - evolution of information systems.

Unit 2: INFORMATION SYSTEM

Functional areas, Finance, marketing, production, personnel - levels, Concepts of DSS, EIS, ES - comparison, concepts and knowledge representation - managing international information system.

Unit 3: SYSTEM DEVELOPMENT

Modern information system - system development life cycle - structured methodologies - designing computer based method, procedures control, designing structured programs.

Unit 4: IMPLEMENTATION AND CONTROL

Testing security - coding techniques - detection of error - validation - cost benefits analysis - assessing the value and risk information systems.

Unit 5: SOFTWARE ENGINEERING

Software engineering qualities - design, production, service, software specification, software metrics, and software quality assurance - software life cycle models - verification and validation.

Reference books:

1. Kenneth C. Laudon and Jane Price Laudon, Management Information systems Managing the digital firm, Pearson Education, Asia.
2. Gordon B.Davis, Management Information system: Conceptual Foundations, Structure and Development, McGraw Hill, 1974.
3. Joyce J. Elam, Case series for Management Information System, Silmon and Schuster, Custom Publishing, 1996.
4. Steven Alter, Information system - A Management Perspective, AddisonWesley, 1999.
5. James AN O‟ Brein, Management Information Systems, Tata McGraw Hill, New Delhi, 1999.
6. Turban Mc Lean, Wetherbe, Information Technology Management making connection for strategic advantage, John Wiley, 1999.
7. Ralph M.Stair and George W.Reynolds, Principles of Information Systems - A Managerial Approach Learning, 2001.

HSS013	COST ANALYSIS AND CONTROL				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: INTRODUCTION TO COSTING
Costing, Elements of costing, Types of cost, Preparation of cost sheet.

Unit 2: COST ANALYSIS
Marginal costing, Cost - volume - Profit analysis, Break-Even-Analysis, Break - Even- Chart, Applications.

Unit 3: CONTROL TECHNIQUES
Budgeting and Budgetary control, Types of Budgets , Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, Zero based Budgeting.

Unit 4: STANDARD COSTING
Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing - Control through variances.

Unit 5: ACTIVITY BASED COSTING
Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory).

Reference books:

1. K.Saxena and C.D. Vashist, Advanced Cost Accounting and Cost Systems, V.Sultan Chand and Sons Publishers.
2. S.P. Jain and K. L. Narang, Advances Cost Accounting Kalyani Publishers.
3. Cost Management, The Institute of Charted Accountants of India.
4. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2005
5. J. Sha, Cases in Cost Management: a Strategic Emphasis by Second Edition. South-Western, 2001
6. Bhabatosh Bangerjee, Financial Policy and Management ,Prentice Hall
7. Anthony.Dearden and Vancil, Management Control Systems, Irwin

HSS014	INTRODUCTION TO MARKETING MANAGEMENT			L	T	P	C
				3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences		
			Course Type	:	Theory		

Unit 1: MARKETING

Meaning - concept - functions - marketing Planning and implementation marketing Programmes - Marketing environment - Market Segmentation and consumer behaviour - Influencing factors, Decision process - Marketing mix - Marketing department

Unit 2: PRODUCT

Meaning - Product planning - policies - positioning - New product development Product life cycle - BCG Matrix-branding. Packing, labeling

Unit 3: PRICING

Pricing objectives - Setting and modifying the price - Different pricing method Product line pricing and new product pricing

Unit 4: DISTRIBUTION

Nature of Marketing channels - Types of Channel flows - Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping

Unit 5: PROMOTION

Promotion Mix - Advertisement - Message - copy writing - Advertisement budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling, publicity and direct marketing

Reference books:

1. Philip Kotler, Marketing Management- Analysis Planning and Control, Prentice Hall of India, New Delhi
2. Cundiff, Still and Govoni, Fundamentals of Modern Marketing, Prentice Hall of India, New Delhi
3. Ramaswamy. V S and Namakumari. S, Marketing Management-Planning Implementation and Control, Macmillan Business Books, 2002
4. Jobber, Principles and Practice of Marketing, McGraw-Hill.

HSS017	INTERNATIONAL ECONOMICS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: INTRODUCTION

The Traditional Theory of International Trade, The Basic Trade Model, Heckscher-Ohlin-Samuelson Model, Effects of Tariffs and Quotas, Theory of Factor Movements - New Theories of International Trade and Industrial Policies

Unit 2: EXCHANGE RATE and BALANCE OF PAYMENT

The Balance of Payments and National Accounts, Determinants of Exchange Rates The Exchange-Rate Regime Choice and a Common Currency Area, International Debt and Currency Crises

Unit 3: INTERNATIONAL REGULATORY AUTHORITY

Political Economy of Trade Disputes, the FTA and the WTO - The role of the IMF and other International Financial Organizations

Reasons for Protection World Trade, International Movements of Capital - The Balance of Trade and Other Measures of International Transactions. Export and import policies

Unit 4: INTERNATIONAL MACROECONOMICS

European Monetary Unification and the Euro - Preferential Trading Arrangements and the NAFTA International Policies for Economic Development, Trade Outsourcing and Off shoring

Reference books:

1. N. Bhagwati, A. Panagariya and T. N. Srinivasan, Lectures on International Trade, MIT Press, 2nd edition, 1998
2. M. Obstfeld and K. Rogoff, Foundation of International Macroeconomics, McGraw-Hill, 1996
3. Romer, D., Advanced Macroeconomics, McGraw Hill, 1996

HSS018	COMMUNICATION SKILLS				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Unit 1: COMMUNICATION IN BUSINESS

Systems approach, forms of business communication, management and communication, factors facilitating communication.

Unit 2: COMMUNICATION PROCESS

Interpersonal perception, selective attention, feedback, variables, listening barriers to listening, persuasion, attending and conducting interviews, participating in discussions, debates and conferences, presentation skills, paralinguistic features, oral fluency development.

Unit 3: BUSINESS CORRESPONDENCE

Business letter. Memos, minutes, agendas, enquiries, orders, sales letters, notice, tenders, letters of application, letter of complaints.

Unit 4: TECHNICAL REPORTS

Format, Choice of vocabulary, coherence and cohesion, paragraph writing, organization.

Unit 5: PROJECT REPORTS

Project proposal, project reports, and appraisal reports.

Reference books:

1. Sharan J.Genrson and Steven M.Gerson, Technical Writing - Process and Product, Pearson Education, 2000.
2. Raymond V.Lesikar, John D. Pettit and Mary E.Flatley, LesikassBasic Communication, Tata McGraw Will, 8th Edition, 1999.
3. Stevel. E. Pauley, Daniel G.Riordan, Technical Report Writing Today, AITBS Publishing and Distributors, India 5th edition, 2000.
4. Robert L.Shurter, Effective letters in business, Third Ed., 1983.
5. McGraith, Basic Managerial Skills for all Prentice Hall of India, 6th Edition, 2002.
6. Halliday, M.A.KyR.Hasan, Cohesion in English, Longman, London, 1976

HSS023	ENTREPRENEURSHIP DEVELOPMENT				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

CO1: To inform the entrepreneurial competence and skill development
CO2: To transverse the business environment to central and state government by industrial policies and regulation.
CO3: To study and outcome of planning of product, and ownership by the evaluation.
CO4: To transverse the lanunching of small business based on the product
CO5: To the outcome of management of small business by effective management.

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2									M						
CO3									M				L		L
CO4													L	L	
CO5		H													L

Unit 1: ENTREPRENEURIAL COMPETENCE

Entrepreneurship concept - Entrepreneurship as a Career - Entrepreneur - Personality Characteristics of Successful. Entrepreneur - Knowledge and Skills Required for an Entrepreneur

Unit 2: ENTREPRENEURIAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business

Unit 3: BUSINESS PLAN PREPARATION

Sources of Product for Business - Pre-feasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria

Unit 4: LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching

Unit 5: MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units - Effective Management of small Business

Reference books:

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. P. Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai,1997.
3. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.
4. Prasama Chandra, Projects - Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, 1996.
5. P.C.Jain (ed.), Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi, 1999.
6. Staff College for Technical Education, Manila and Centre for Research and Industrial Staff Performance, Bhopal, Entrepreneurship Development, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.

HSS025	SCIENCE FICTION: AN APPRECIATION				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course Objectives:

This advanced optional course aims at a close analytical study of the impact of science and technology on Man and his several institutions in society as expressed in science fiction. It introduces the students to some samples of science fiction, and through a critical discussion and analysis helps them appreciate the creative link between scientific discoveries and technological inventions and human civilization. Finally, it will further improve the student's ability to analyse scientific concepts in extended discussions and compositions. Special emphasis will be laid on increasing ability and style.

HSS026	GERMAN - I				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

German for science and technology, based on the book „German for science and Technology" by stecker/Davids, for beginners grammar, noun group; verb, prepositions, pronouns, modal verbs, compound verbs, reading and translating practice. Simple colloquial German.

HSS028	FRENCH - I				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Definite and indefinite articles - Adjectives - agreement with their nouns - Conjucation of verbs; to have, to be affirmative, negative and interrogative forms - Possessive adjectives. Contraction of „of the" „to the" (Singular and Plural) - demonstrative adjectives - The three groups of verbs - present perfect tense with „to have" and „to be" - The partitive article - Future tense - immediate future recent past - Reflexive verbs - Present perfect of reflexive verbs.

HSS030	SCI., TECH AND MEDICINE IN INDIA: A HISTORICAL PERSPECTIVE				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course Objectives:

This course is designed to provide a broad historical overview of the growth of science, technology and medicine in India. It aims to explicate to the students the rich scientific and technological heritage of India and the positive response to the abvent of modern science through the colonial agency, resulting in the emergence of a viable modern scientific community in India.

Unit 1:

Early Indian approaches to the universe, understandings of the physical world, theories of matter and the quest to transcend existential limitations

Unit 2:

Development of science and medicine till the colonial era. Astronomy of the Vedas and Aryabahata, Varmaihira and Bhaskar I, Brahmagupta, the Arab connection, Sawai Jai Singh, Mathematics and Geometry: Shulabha Sutra, the Indian numerals, the decimal notations, calendars and algebra. Medicine and Surgery: Charaka ans Sushruta Samhitas, Physiology, Anatomy, Meteria Medica, Unani and Ayurveda. Physical and Botanical Sciences, Antiquity of Indian Chemistry and Alchemy

Unit 3:

Advancements in Technology till pre-colonial times: Metallurgy, Artillary, Gun Powder technology, Persian Wheel, textile technology, the charka, bleaching, dyeing, Architecture: Monuments, Bridges, Naval Architecture, Shipbuilding and Agricultural technologies

Unit 4:

Advent of colonial science: Early colonial settlement and scientific exploarations. The East India company - Surveyors, Botanists and Doctors under the company‟s Service, The Indian Medical Service, Encounters with Indian medicine, Introduction of stream technologies, Railways, Textiles, Mining, Telegraphs, Canals and Dams

Unit 5:

Indian response to modern science, the colonial restrictions and limitation, Science and nationalism and the emergence of the Indian scientific community

Reference Books:

1. Arnold, David, Science, Technology and Medicine in colonial India Cambridge, 1999
2. Bose, D.M.S.N. Sen, and B.V. Subarayappa, A Coincise History of science in India, New Delhi. 1971
3. Chattopadhayaya, Debiprasad, Science and Society in Ancient India, Calcutta, 1979
4. Headrick, D.R., The Tools of Empire: Technology and European Imperialism in the Nineteenth Century, New York, 1981
5. Jaggi, O.P History of Science, Technology and Medicine in India, 15 volumes, Delhi, 1969-84.
6. Kumar, Deepak, Science and the Raj, Delhi, 1995
7. Lourdusamy, J.B., (forthcoming) Science and National Consciousness in Bengal, c 1870-1930, Hyderabad, (Jan 2004)
8. Macleod, Roy and Deepak Kumar, eds., Technology and Culture, Delhi, 1982
9. Qaisar, AJ The Indian Response to European Technology and culture, Delhi, 1982
10. Sen, S.N. Cultural Heritage of India, Vol vi., Calcutta, 1972

HSS033	MODERN SCIENCE IN INDIA				L	T	P	C
					3	0	0	3
Pre-Requisite	:	NIL	Course Category	:	Humanities and Social Sciences			
			Course Type	:	Theory			

Course Objectives:

The course is deal with the advent and growth of modern science in India under the aegis of colonialism and the Indian response to it. It would delineate the many ways in which the entire process was implicated not only in the political axis of colonialism and nationalism but also in the various socio-cultural developments of the period.

Unit 1:

What is modern Science? - The Scientific Revolution and the rise of modern science in the [1500 - 1700]

Unit 2:

The advent of modern science in India: Early travelers, missionaries, colonial settlements and scientific explorations, The east India Company - surveyors, botanists and doctors under the company‟s service, The Asiatic Society [1500-1757].

Unit 3:

Institutionalized Colonial Science: The various scientific departments, the Indian medical service, Introduction of new technologies - Railways, Textiles, Mining, Telegraphs, Canals and Dams. [1757-1900]

Unit 4:

Science education in colonial India: Origins of English and western education, founding of the Universities, the content of science in the curricula, setting up of technical institutes, the restrictions and limitations of colonialism. [1980-1930]

Unit 5:

The Indian response: Response to English Education, its implications for indigenous society and culture, and the role of social and religious reformers, the taste for modern science, setting up of indigenous society for the learning and cultivation of modern science. [1830-1930]

Reference books:

1. Arnold David Science, Technology and Medicine in Colonial India, Cambridge: Cambridge University Press 2000
2. Headrick, D.R., The Tools of Empire: Technology and European Imperialism in the Nineteenth Century, New York, 1981
3. Kuma Deepak Eds. Science and Empire: Essays in the Indian context, Delhi: Anamika Prakashan, 1991, Science and the Raj, 1857-1905. Delhi: Oxford University Press 1995
4. Qaisar, A J., The Indian response to European technology and culture, Delhi: Oxford University Press 1982
5. Sangwan S Science, Technology and colonization: Indian Experience, Delhi: Anamika Prakashan, 1990

HSS032	FOOD PROCESSING ENTERPRISE				L	T	P	C
					3	0	0	3
Pre-Requisite	**:**	NIL	**Course Category**	**:**	Humanities and Social Sciences			
			Course Type	**:**	Theory			

CO1: Describe the basic management, finance and marketing problem solving in industrial and business
CO2: Transverse the apply of environmental analysis and launching the market
CO3: Explain the food and agricultural policy to rural area
CO4: State the input of agricultural product in marketing
CO5: Explain the agribusiness in retail and supply

Mapping of course outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L											M	L		
CO2	M						L					L			
CO3	M					M									
CO4	L											L			
CO5	M											L			

UNIT-I
Element in Enterprise Management: Basic management concepts, personnel, production, materials, financing and marketing managements, problem solving and innovation, industrial and business law. Entrepreneurial motivation.

UNIT-II
Environmental analysis, project selection, project appraisal, modification/ finalization of project, collaborations, preparations for launching, trial run and test marketing.

UNIT-III
Management of agribusiness projects and enterprise. Management of agribusiness trade in WTO environment. Agricultural and food policy. Rural environment and institution.

UNIT-IV
Marketing of Agricultural input and Marketing of Agricultural product. Market research for agribusiness.

UNIT-V
Commodity trading and forecasting for agribusiness. Retail and supply chain management. Management of cooperation.

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