KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 052
(Autonomous)

VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Providing value based quality education for the development of students as competent and responsible citizens.
- Contributing to the nation and beyond through research and development
- Continuously improving our services

DEPARTMENT OF FOOD TECHNOLOGY

VISION

To be a centre of excellence for development and dissemination of knowledge in the field of Food Technology for the nation and beyond

MISSION

Department of Food Technology is committed to:

MS1: Develop vibrant, competent and ethical food engineers who can promote technical advancements in the field of Food Technology.

MS2: Foster the research activities of faculty and students to explore the state-of- the-art techniques to meet the industrial and societal needs.

MS3: Endeavour for constant upgradation of technical expertise to support continuous learning

2011 REGULATIONS
PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Food Technology will

PEO1: Apply principles of basic sciences, and engineering to succeed in their professional career

PEO2: Analyze, design and develop food processes/products that are technically feasible, economically viable and socially relevant

PEO3: Exhibit professional and ethical codes of conduct and an aptitude for continuous learning for catering to the ever changing needs of the society

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	2	3
MS2	3	3	2
MS3	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Food Technology will be able to

a. Apply the knowledge of mathematics, science and engineering to solve domain specific engineering problems

b. Identify, analyze, and formulate the Food Technology problems based on knowledge of basic science and engineering

c. Design and develop Food Technology based a processes /products to meet the desired requirements

d. Investigate complex engineering problems in the Food Technology domain to arrive suitable solutions

e. Apply the techniques, skills and modern engineering tools to solve domain specific problems with realistic constrain

f. Apply engineering solutions in global and societal contexts

g. Understand the impact of engineering solutions on environment in a global perspective to ensure sustainability

h. Discharge responsibilities by exhibiting professional and ethical values

i. Function effectively as an individual or as part of a multidisciplinary team to accomplish a common goal

j. Communicate effectively at various levels in oral and written forms

k. Exhibit knowledge of project management and finance useful to become an entrepreneur

l. Recognize the need for lifelong learning in the context of continuous technological and other changes.

MAPPING OF PEOs WITH POs

PEO\PO	a	b	c	d	e	f	g	h	i	j	k	l
PEO1	3	3	2	2	2	2	1	1	1	1	1	2
PEO2	3	3	3	3	3	3	2	2	1	1	2	3
PEO3	1	1	1	1	1	2	3	3	2	2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2011

Curriculum Breakdown Structure(CBS)	**Curriculum Content (% of total number of credits of the program)**	**Total number of contact hours**	**Total number of credits**
Basic Sciences(BS)	18.78	570	34
Engineering Sciences(ES)	7.73	270	14
Humanities and Social Sciences(HS)	8.84	270	16
Program Core(PC)	52.49	1815	95
Program Electives(PE)	6.63	180	12
Project(s) (PR)	4.97	270	09
Industrial Training (IT)	0.55	120	01
		Total	**181**

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B. Tech. DEGREE IN FOOD TECHNOLOGY

CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11EL101	Technical English	3	0	0	3	50	50	100	HS
11MA101	Engineering Mathematics-I	3	1	0	4	50	50	100	BS
11PH101	Applied Physics	3	0	0	3	50	50	100	BS
11CY101	Applied Chemistry	3	0	0	3	50	50	100	BS
11CS101	Problem Solving and Programming	3	0	0	3	50	50	100	ES
11EE101	Basics of Electrical and Electronics Engineering	3	0	0	3	50	50	100	ES
	PRACTICAL								
11PH102	Physical Sciences Laboratory-I	0	0	3	1	50	50	100	BS
11CS102	Programming Laboratory	0	0	3	1	50	50	100	ES
				Total	**21**				

CA- Continuous Assessment, ESE- End Semester Examination
CBS – Curriculum Breakdown Structure

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B. Tech. DEGREE IN FOOD TECHNOLOGY

CURRICULUM
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SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11EL201	Communication Skills	3	0	0	3	50	50	100	HS
11MA201	Engineering Mathematics-II	3	1	0	4	50	50	100	BS
11PH201	Materials Science	3	0	0	3	50	50	100	BS
11CY201	Environmental Science	3	0	0	3	50	50	100	BS
11ME101	Basics of Civil and Mechanical Engineering	3	0	0	3	50	50	100	ES
11ME102	Engineering Drawing	2	0	3	3	50	50	100	ES
	PRACTICAL								
11PH202	Physical Sciences Laboratory-II	0	0	3	1	50	50	100	BS
11ME103	Engineering Practices Laboratory	0	0	3	1	50	50	100	ES
11EL202	Communication Skills Laboratory	0	0	3	1	50	50	100	HS
				Total	**22**				

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SEMESTER - III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA301	Engineering Mathematics - III	3	1	0	4	50	50	100	BS
11FT301	Fluid Mechanics for Food Technologist	3	1	0	4	50	50	100	PC
11FT302	Food Process Calculations	3	1	0	4	50	50	100	PC
11FT303	Engineering Properties of Food Materials	3	0	0	3	50	50	100	PC
11FT304	Fundamentals of Biochemistry	3	0	0	3	50	50	100	PC
11FT305	Principles of Microbiology	3	0	0	3	50	50	100	PC
	PRACTICAL								
11FT306	Unit Operations Laboratory - I	0	0	3	1	50	50	100	PC
11FT307	Biochemistry Laboratory	0	0	3	1	50	50	100	PC
11FT308	Microbiology Laboratory	0	0	3	1	50	50	100	PC
				Total	**24**				

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CBS – Curriculum Breakdown Structure

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SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA401	Numerical Methods	3	1	0	4	50	50	100	BS
11FT401	Applied Thermodynamics	3	1	0	4	50	50	100	PC
11FT402	Heat Transfer in Food Processing Operations	3	1	0	4	50	50	100	PC
11FT403	Mass Transfer for Food Technologist	3	1	0	4	50	50	100	PC
11FT404	Biochemistry of Processing and Preservation of Foods	3	0	0	3	50	50	100	PC
11FT405	Food Microbiology	3	0	0	3	50	50	100	PC
	PRACTICAL								
11FT406	Unit Operations Laboratory -II	0	0	3	1	50	50	100	PC
11FT407	Food Chemistry Laboratory	0	0	3	1	50	50	100	PC
11FT408	Food Microbiology Laboratory	0	0	3	1	50	50	100	PC
				Total	**25**				

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CURRICULUM

(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11FT501	Food Process Engineering - I	3	1	0	4	50	50	100	PC
11FT502	Refrigeration and Cold Chain Management	3	1	0	4	50	50	100	PC
11FT503	Dairy Engineering	3	0	0	3	50	50	100	PC
11FT504	Milling Technology for Food Materials	3	0	0	3	50	50	100	PC
11FT505	Baking and Confectionery Technology	3	0	0	3	50	50	100	PC
11FT506	Fruit and Vegetable Processing Technology	3	0	0	3	50	50	100	PC
	PRACTICAL								
11FT507	Dairy Engineering Laboratory	0	0	3	1	50	50	100	PC
11FT508	Baking and Confectionery Laboratory	0	0	3	1	50	50	100	PC
11FT509	Fruit and Vegetable Processing Laboratory	0	0	3	1	50	50	100	PC
				Total	**23**				

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SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE601	Economics and Management for Engineers	3	0	0	3	50	50	100	HS
11MA601	Probability and Statistics	3	1	0	4	50	50	100	BS
11FT601	Process Instrumentation and Control	3	1	0	4	50	50	100	PC
11FT602	Food Process Engineering - II	3	1	0	4	50	50	100	PC
11FT603	Food Quality Assurance and Control	3	1	0	4	50	50	100	PC
11FT604	Meat, Fish and Poultry Process Technology	3	0	0	3	50	50	100	PC
	PRACTICAL								
11FT605	Food Process Engineering Laboratory	0	0	3	1	50	50	100	PC
11FT606	Food Analysis And Quality Control Laboratory	0	0	3	1	50	50	100	PC
				Total	**24**				

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CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – VII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE701	Total Quality Management	3	0	0	3	50	50	100	HS
11FT701	Food Packaging Technology	3	0	0	3	50	50	100	PC
11FT702	Food Process Plant Layout and Safety	3	0	0	3	50	50	100	PC
11FT703	Plantation and Spices Products Technology	3	0	0	3	50	50	100	PC
	Elective - I	3	0	0	3	50	50	100	PE
	Elective - II	3	0	0	3	50	50	100	PE
	PRACTICAL								
11FT704	Food Packaging Laboratory	0	0	3	1	50	50	100	PC
11FT705	Food Process Equipment Design and Drawing Laboratory	0	0	3	1	50	50	100	PC
11FT706	Industrial Training	0	0	0	1	-	100	100	IT
				Total	**21**				

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B. Tech. DEGREE IN FOOD TECHNOLOGY

CURRICULUM
(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – VIII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE801	Professional Ethics and Human Values	3	0	0	3	50	50	100	HS
11FT801	Industrial Waste Water Treatment	3	0	0	3	50	50	100	PC
	Elective – III	3	0	0	3	50	50	100	PE
	Elective – IV	3	0	0	3	50	50	100	PE
	PRACTICAL								
11FT802	Project Work	0	0	18	9	100	100	200	PR
				Total	**21**				

CA - Continuous Assessment, ESE - End Semester Examination
CBS – Curriculum Breakdown Structure

LIST OF ELECTIVES						
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**CBS**
11CH704	Material Technology for Process Industries	3	0	0	3	PE
11FT011	Emerging Technologies in Food Processing	3	0	0	3	PE
11FT012	Advances in Drying Technology	3	0	0	3	PE
11FT013	Computer Applications in Food Engineering	3	0	0	3	PE
11FT014	Analytical Instruments in Food Industries	3	0	0	3	PE
11FT015	Technology of Fats and Oils	3	0	0	3	PE
11FT016	Technology of Snack And Extruded Foods	3	0	0	3	PE
11FT017	Technology of Milk and Milk Products	3	0	0	3	PE
11FT018	Beverage Technology	3	0	0	3	PE
11FT019	Cane Sugar Technology	3	0	0	3	PE
11FT020	Fermentation Technology	3	0	0	3	PE
11FT021	Food Additives and Nutraceuticals	3	0	0	3	PE
11FT022	Enzymes in Food Processing	3	0	0	3	PE
11FT023	Advanced Separation Techniques	3	0	0	3	PE
11FT024	Down Stream Processing of Bio Products	3	0	0	3	PE
11FT025	Food Biotechnology	3	0	0	3	PE
11GE011	Entrepreneurship Development	3	0	0	3	HS
11FT026	Food Laws & Safety	3	0	0	3	PE
11FT027	Food Process Equipment Design	3	0	0	3	PE
11FT028	Byproducts Utilization in Food and Agro Industries	3	0	0	3	PE

11EL101 TECHNICAL ENGLISH

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **17**

Grammar and Vocabulary: Word formation with prefixes and suffixes – Synonyms and Antonyms – Verb Patterns – Tenses (simple and compound tenses) - Simple, Compound and Complex Sentences - Voice – Use of Conditionals - Comparative Adjectives (affirmative and negative) – Expanding Nominal compounds - Articles - Use of Prepositions – Identifying Odd Words – Acronyms.

MODULE – II **13**

Listening: Listening for General Content – Intensive Listening – Listening for Specific Information : Retrieval of Factual Information – Listening to Identify Topic, Context, Function, Speaker's Opinion, Attitude, etc. – Global Understanding Skills and Ability to infer, extract gist and understand main ideas – Note-taking: Guided and unguided-Listening to fill up gapped texts.

Writing: Introduction to the Characteristics of Technical Style - Writing Definitions and Descriptions - Paragraph Writing (topic sentence and its role, unity, coherence and use of cohesive expressions) - Process Description(use of sequencing connectives)– Comparison and Contrast - Classifying the data - analysing / interpreting the data – Personal letter - Formal letter writing (Inviting Guest Speakers, letter to the editor, letter for seeking practical training, and letter for undertaking project works in industries) – editing (punctuation, spelling and grammar) – Recommendations & Suggestions.

MODULE- III **15**

Reading: Exposure to different Reading Techniques - Reading for Gist and global meaning - Predicting the content - Skimming the text – Identifying the Topic Sentence and its role in each paragraph - Scanning - Inferring / identifying lexical and contextual meanings - Reading for structure and detail - Transfer of information / guided note-making - Understanding discourse coherence - Sequencing of sentences.

Speaking: Verbal and Non Verbal Communication - Pronunciation drills/ Tongue Twisters – Formal and Informal English - Oral practice – Developing Confidence - Introducing Oneself - Asking for or Eliciting Information - Describing Objects – Offering Suggestions and Recommendations – expressing opinions (agreement / disagreement.

TOTAL : 45

TEXT BOOK

1. "English for Engineers and Technologists", Combined Edition, Volume. I & II, Orient Longman, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS

1. Aysha Viswamohan, "English for Technical Communication", Tata McGraw-Hill, New Delhi, 2008.
2. Rizvi M Ashraf, "Effective Technical Communication", Fifth Edition, Tata McGraw- Hill, New Delhi, 2007.
3. Mark Ibbotson, "Cambridge English for Engineering", Cambridge University Press, New Delhi, 2009.
4. Rama Krishna Rao, A, "Learning English: A Communicative Approach" Orient Black Swan, Hyderabad, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: improve their vocabulary and appropriate usage of words in different academic and professional contexts.
CO2: familiarize with different rhetorical functions of technical English.
CO3: develop strategies that could be adopted while reading texts.
CO4: speak effectively in English and career related situations.
CO5: acquire knowledge in academic and professional writing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
CO1									2	3		1
CO2									2	3		
CO3				2					2	3		1
CO4									2	3		
CO5				1					1	3		1

3 – Substantial, 2 – Moderate, 1 – Slight

11MA101 ENGINEERING MATHEMATICS – I

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Matrices: Linear independent and dependent of vectors – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of eigen values and eigen vectors (without proof) – Cayley – Hamilton theorem (without proof).

Diagonalisation: Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Nature of quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE – II **15**

Differential Calculus: Curvature – Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature. Involutes and evolutes – Envelopes – Properties of envelopes and evolutes.

Functions of several variables: Functions of two variables – Partial derivatives – Total differential – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians.

MODULE - III **15**

Differential Equations: Linear differential equations of Second and higher order with constant coefficients when the R.H.S is e^{ax}, x^n, $n > 0$, Sinax, Cosax, $e^{ax}x^n$, $e^{\alpha x}$ Sinβx, $e^{\alpha x}$ Cosβx, x^n Sinαx and x^n Cosαx– Differential Equations with variable coefficients (Cauchy's form). Method of variation of parameters - Simultaneous first order linear equations with constant coefficients.

Applications of Differential Equations: Solution of specified differential equations connected with electric circuits, simple harmonic motion (Differential equations and associated conditions need to be given).

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy. P, Thilagavathy. K and Gunavathy. K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2011, S.Chand and Co., New Delhi.
2. Veerarajan. T., "Engineering Mathematics, (for first year)", Reprint Edition 2011, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House, New Delhi, 2007.
3. Bali N.P and Manish Goyal, "Text Book of Engineering Mathematics", 3rd Edition, Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Solve engineering problems which needs matrix computations.

CO2: Utilize the geometrical aspects of differential calculus and extremal problems which arise in function of several variables.

CO3: Apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		1	2							1
CO2	3	3										1
CO3	3	3		1	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11PH101 APPLIED PHYSICS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Acoustics : Classification of sound – Characteristics of musical sound – Weber-Fechner law – Absorption Coefficient – Reverberation – Reverberation time – Sabine's formula (growth & decay) – Factors affecting acoustics of buildings (reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies.

Ultrasonics : Introduction – Production – Magnetostriction effect – Magnetostrictive generator - Inverse piezoelectric effect - Piezoelectric generator - Detection of ultrasonics - Properties – Cavitation - Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non destructive testing – Ultrasonic pulse echo system - Medical applications – A, B and C Scan displays – Ultrasonic imaging technique.

MODULE – II **15**

Lasers: Introduction – Principle of spontaneous emission and stimulated emission - Population inversion, Pumping, Einstein's Coefficients (A&B) - Types of lasers – Nd:YAG, CO_2, Semiconductor lasers: Homojunction and Heterojunction – Laser Applications – Industrial applications – Laser welding, Laser cutting, Laser drilling – Holography – Construction and reconstruction of images.

Fiber Optics & Applications: Principle – Classification based on materials, Modes of propagation, Refractive index profile - Crucible-crucible technique of fiber fabrication - Light sources for fiber optics – Detectors - Fiber optical communication links - Losses in optical fibers – Fiber optic sensors – Temperature, displacement, voltage and magnetic field measurement.

MODULE - III **15**

Quantum Physics and Applications: Black body radiation – Planck's theory (derivation)– Deduction of Wien's displacement law and Rayliegh – Jean's Law from Planck's theory – Compton effect – Theory and experimental verification - Matter waves – Uncertainty principle - Experimental verification – Schroedinger's wave equations – Time independent and time dependent equation – Physical Significance of wave function – Particle in a box (One dimensional) - Optical microscope – Limitations of optical microscopy - Scanning electron microscope - Transmission electron microscope.

TOTAL : 45

TEXT BOOKS

1. Avadhanalu M N and Kshirsagar P G, "A Text Book of Engineering Physics", S.Chand & company Ltd, New Delhi, 2007.
2. Palanisamy P K, "Engineering Physics", Scitech Publications, Chennai, 2008.

REFERENCE BOOKS

1. Gaur R K and Gupta S L , "Engineering Physics", Dhanpat Rai and Sons, New Delhi, 2006.
2. Rajendran V, "Engineering Physics", Prentice Hall of India, New Delhi, 2008.
3. Rajagopal K, "Textbook of Engineering Physics", Part I, PHI Learning Pvt. Ltd., New Delhi, 2008.
4. Personick S D, "Fibre Optics, Technology and Applications", Khanna Publishers New Delhi, 1987.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Infer and apply the basic concepts of design of acoustically good buildings and ultrasonic in engineering and technology.

CO2: Demonstrate the basics of fiber optic communication system and laser phenomena, and make use of them in engineering and technology.

CO3: Relate and inference the concepts of quantum physics to optical, electrical and other physical phenomena.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		2						2		1
CO2	3	3		2						2		1
CO3	3	3		2						2		1

3 – Substantial, 2 – Moderate, 1 – Slight

11CY101 APPLIED CHEMISTRY

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Water: Introduction - Sources of water - impurities in water - Types of water - Water quality standards - Water quality parameters (Discussion not required) - Hardness of water- Expression of hardness - Units of hardness –Estimation of Hardness of water by EDTA method – Determination of alkalinity - Disadvantages of using hard water - Boiler troubles due to hard water - scale and sludge formation – Boiler corrosion – caustic embrittlement- priming and foaming-Softening of water- External treatment methods - Lime soda, zeolite and demineralization process (principle, process, advantages and disadvantages only) Internal treatment process - colloidal, carbonate, calgon and phosphate conditioning (brief discussion only) - desalination by reverse osmosis method. **Electrochemistry:** Introduction - Cells – Representation of a galvanic cell - EMF measurements and its applications – Electrode potential - Nernst Equation – Reference electrodes (hydrogen and calomel electrodes) – Electrochemical series and its applications – Conductometric titrations (strong acid Vs strong base only) - Batteries – Lead acid and Ni-Cd batteries.

MODULE – II **15**

Corrosion and Its Control: Introduction – Mechanism of dry and wet corrosion – galvanic corrosion - concentration cell corrosion – Galvanic series - Factors influencing rate of corrosion – corrosion control methods - Sacrificial anode and impressed current cathodic method – Corrosion inhibitors - Protective coatings - classifications - Pretreatment of metal surface - Metallic coating -electroplating and electrolessplating (General discussion) - Hot dipping (Tinning and galvanising) - Nonmetallic coating - surface conversion coating (phosphate coating and anodized coating) - Organic coating - paints – constituents and their function – Special paints (Fire retardant, temperature indicating, water repellant and luminescent paints) **Combustion:** Introduction – Calorific Values – Gross and net – Theoretical calculation of minimum air for combustion (Theoretical aspects only) – flue gas analysis – Orsat's method - Explosive range and Spontaneous Ignition Temperature.

MODULE - III **15**

Fuels: coal – proximate and ultimate analysis – their importance – metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - refining of petroleum - Straight run, cracked and polymer petrol – Manufacture of synthetic petrol - polymerization (thermal and catalytic methods) - Hydrogenation of coal (Fisher Tropsch and Bergius methods) - knocking - octane number – improving octane number by additives – Diesel – cetane number – Gaseous fuels (Water gas, producer gas and biogas)

Polymers: Introduction – Nomenclature of polymers – functionality – polymerization - types – addition, condensation and co-polymerization with examples – Effect of polymer structure on properties (strength, plastic deformation, crystallinity and chemical resistance) - plastics – types (thermo and thermosetting plastics) - individual polymers - Polyethylene, polypropylene, PVC, Teflon, Bakelite and epoxy resin (preparation, properties and uses only) - Compounding of plastics-Fabrication of plastics (compression, injection and extrusion moulding methods) – conducting polymers

TOTAL : 45

TEXT BOOK

1. Jain PC and Monica Jain, "Engineering Chemistry", 15th Edition, Dhanpat Rai publication Co., New Delhi, 2008.

REFERENCE BOOKS

1. Dara S.S., "A Text Book of Engineering Chemistry", S.Chand & Co. Ltd., New Delhi, 2006.
2. Sharma B.K., "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut, 2001.
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill, New Delhi, 2008.
4. Krishnamurthy N., "Engineering Chemistry", 2nd Edition, PHI Learning private Limited, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Represent the water quality parameters, water treatment methods for potable and industrial purpose and apply the principles of electrochemistry for EMF measurement and energy storing devices

CO2: Comprehend the effect of corrosion and corrosion control methods.

CO3: Represent the calculation for calorific values, theoretical amount of minimum air required for complete combustion and flue gas analysis.

CO4: Represents the types of fuel, engines, some individual polymers, fabrications of plastics.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2		2	1	2	3			3		3
CO2	3	2		2	1	2	3			3		3
CO3	3	2		2	1	2	3			3		3
CO4	3	2		2	1	2	3			3		3

3 – Substantial, 2 – Moderate, 1 – Slight

11CS101 PROBLEM SOLVING AND PROGRAMMING

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Basics: Evolution of computers- Generations of computers- Classification of computers- Applications of computers- Hardware - Software-Information Technology-Internet Problem-Solving Techniques- Program Control Structures- Programming Paradigms and Languages-Generations of Programming Languages.

Problem Solving: Introduction – Problem Solving Aspects- Top-Down Design-Implementation of Algorithms-Program Verification- Efficiency of Algorithms- Analysis of Algorithms- Fundamental algorithm- Factorial Computation - Generation of Fibonacci Sequence.

MODULE – II **15**

C Fundamentals and Arrays: Introduction to C – C programming structure – C character set – Identifiers – keywords. Data types – Constants – variables- Operators – Expressions – Library functions Managing Input and Output – formatted input and output. Control statements – Decision making and branching – Looping structures- Arrays – One dimensional array – Two dimensional arrays – Multidimensional arrays. Character arrays and strings.

MODULE - III **15**

Functions, Structures and Files: Functions - User defined functions: declaration, definition function call and parameter passing mechanisms – Recursion –Array and Functions - User defined data types –typedef - Structures – Unions –File operations in C- Introduction to pointer –Pointer Declaration and Initialization-Accessing a Variable through a pointer-Difference between array and Pointers.

TOTAL : 45

TEXT BOOKS

1. Kamthane, Ashok N. “Computer Programming”, Pearson Education, New Delhi, 2007.
2. Dromey, R.G., “How to solve it by Computers”, Pearson Publishers, New Delhi, 2007.

REFERENCE BOOKS

1. Gottfried Byron S, “Programming with C”, Second Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Kanetkar Yashavant P., “Let us C”, Fifth Edition, BPB publications, New Delhi, 2005.
3. Schildt Herbert, “The Complete Reference C”, Fourth Edition, Tata McGraw-Hill, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline the changes in hardware and software technologies with respect to evolution of computers and programming languages

CO2: Apply fundamental principles of problem solving techniques

CO3: Develop programs using basic programming principles of C language

CO4: Design simple applications using structured programming techniques and file concepts

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2											3
CO2	3	3	3		2							2
CO3	3	3	2	1								2
CO4	3	3	3	1								2

3 – Substantial, 2 – Moderate, 1 – Slight

11EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to Civil, Mechanical, Chemical, Food Technology, Computer Science and Information Technology branches)

3 0 0 3

MODULE – I **15**

Electrical Systems: Kirchhoff's Laws – Resistors in series and Parallel, Voltage and Current division Rule, Mesh Analysis of Simple Resistive networks – Introduction to AC Circuits – Sinusoidal Voltage, Current, R.M.S and Average value.

Power System: Introduction- Structure of electric power system- Transmission and Distribution systems – Various levels of Transmission and Distribution Voltages.

Electrical Machines: DC Machines Construction, Principle of Operation, Basic Equation and Applications of: DC Generators (EMF equation), DC Motors (Torque equation).

MODULE – II **15**

AC Machines: Single Phase Transformer- Construction and Working Principle of Three Phase Induction Motors- Single Phase Induction Motors: Split Phase and Capacitor Start Motors.

Semiconductor Devices and Applications: Semiconductors and Junction Diodes : Distinction between Conductors, Semiconductors and Insulators – Properties of Semiconductors – PN Junction Diode- Rectifiers and Filters- Zener Diodes – Zener Diode Voltage Regulator– LEDs. Junction Transistors: Principle of Operation – CE,CB and CC Configurations – Static Characteristics – CE Transistor as an Amplifier – Characteristics and Applications of SCR and UJT.

Digital Electronics: Introduction– Binary Number Systems and Conversions – Binar``````````````````y Addition and Subtraction -Logic Gates and Truth tables.

MODULE - III **15**

Digital Electronics: Boolean Algebra: Basic laws and Demorgan's theorem – Simplification of Boolean Functions —Full Adder and Full Subtractor – Flip-Flops: RS,JK,D and T – Counter: 4 Bit Binary Ripple Counter.

Linear IC'S: OPAMPs: – Ideal Characteristics –Applications of OP-Amps: Inverting and Non-Inverting Amplifier, Voltage Follower, Adder and Subtractor.

Fundamentals of Communication Engineering: Introduction – Need for Modulation – Amplitude Modulation – Frequency Modulation – Comparison of AM & FM Communication Systems (Block Diagram approach): Radio, TV: Standards, Transmitter and Receiver- Satellite and Optical Fibre Communication

Powersupplies (Block Diagram Approach) : Regulators, UPS and SMPS

TOTAL : 45

TEXT BOOKS

1. Hughes Edward., Smith Mckenzie., Hiley John and Brown Keith., "Electrical and Electronic Technology", 9th Edition, Pearson Education, New Delhi.
2. Muthusubramanian, Salivahanan R.S. and Muraleedharan K.A., "Basic Electrical, Electronics and Computer Engineering", Tata McGraw-Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Millman and Halkias, "Integrated Electronics", Tata McGraw-Hill, New Delhi, 1998.
2. Kennedy, David, "Electronic Communication Systems", Tata McGraw – Hill, New Delhi, 2000.
3. Gayakward, Ramakant A. "Op-Amps and Linear Integrated Circuits", Pearson Education, New Delhi, 2002.
4. Metha, V.K and Rohit Mehta, "Principles of Power System", S. Chand & Company Ltd., New Delhi, 2006.
5. Smarajit Ghosh, "Electrical and Electronics Engineering", Second Edition, Prentice Hall of India, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: develop a basic understanding of the concept of electrical systems

CO2: illustrate the construction and working of different types of electric machines

CO3: gain basic knowledge of analog and digital electronics, communication engineering

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3			3								
CO2	3											
CO3	3								3			

3 – Substantial, 2 – Moderate, 1 – Slight

11PH102 PHYSICAL SCIENCES LABORATORY – I

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength and angle of divergence.
   (c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Determination of dispersive power of a prism using spectrometer.
6. Determination of Young's modulus of the material – non uniform bending.

PART-B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Estimation of Total, Temporary and Permanent hardness of water by EDTA method.
2. Estimation of Ca^{2+} and Mg^{2+} hardness separately by EDTA method.
3. Estimation of Alkalinity of a water Sample.
4. Conductometric titration - Mixture of acids.
5. Estimation of Hydrochloric acid using PH meter.
6. Estimation of Ferrous ion by Potentiometric titration.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Get a basic idea of diode and LASER.

CO2: Familiarize the concepts of Ultrasonic.

CO3: Get a basic idea about the analysis of hardness, amount of Ca^{2+} and Mg^{2+} , presence of alkalinity in water

CO4: Get a basic idea about the handling of instruments like pH meter and conductivity meter for the estimation of unknown concentration of acids.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		2						1		1
CO2	3	3		2						1		1
CO3	3	2		2						3		3
CO4	3	2		2						3		3

3 – Substantial, 2 – Moderate, 1 – Slight

11CS102 PROGRAMMING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

A) APPLICATION PACKAGES

1. To create an advertisement using word
2. To illustrate the concept of mail merging using word
3. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts using excel
4. To create the presentation for the department using power point
5. To create the presentation for digital computers using power point

B) C PROGAMMING (ANY TWO PROGRAMS IN EACH SECTION)

6. Simple programs using decision making and branching:
   a. Program to find biggest of three numbers
   b. Design of simple menu driven calculator
   c. Program to find the roots of the quadratic equation
   d. Program to convert the given decimal number to binary
   e. Program to print the prime numbers between 100 to 500
   f. Program to print the electricity bill in a specified format applying specified rules
7. Programs using arrays:
   a. Program to find the biggest number in the array
   b. Menu driven program to insert and delete a specified element from the array
   c. Program to arranged the elements of the array in ascending order
   d. Program to merge given two one dimensional arrays and to remove the duplicates
   e. Program for multiplication of two matrices
8. String manipulations:
   a. Program to find the length of the string, copy one string to another and compare two strings, concatenate two strings without using library functions.
   b. Program to check whether the given string is a palindrome or not without reversing
   c. Program to find the occurrence of a substring in a main string and replace the substring by another string.
   d. Arranging the list of names in alphabetical order
   e. Program to count the number of occurrences of vowels, consonants, words, white spaces and special characters in the given statement.
9. Functions:
   a. Program to swap the contents of two variables using functions (Pass by address and pass by reference)
   b. Program to print the Fibonacci series using recursive function
   c. Program to print the average and standard deviation of the elements of the one- dimensional array using function.
   d. Program to print the transpose of a matrix using functions
   e. Menu driven program to perform string operations using functions
10. Structures and file operations:
    a. Define a structure to store the student details viz., Roll no, name, marks in three subjects, total, avg and class obtained. Read the first three fields and write your logic to calculate the total, average and class obtained for ten students. Print the results in the order of ran obtained.
    b. Structure based program to print the pay slip of an employee.
    c. Program using files to copy the contents of one file to another

REFERENCES / MANUALS/SOFTWARE:

Software requirements

Operating System : Windows / Linux

Compiler : C compiler

Packages: MS office or Equivalent

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: utilize the features of MS office package to create documents, presentation and reports

CO2: write and execute programs to illustrate decision making and branching

CO3: develop programs using 1D and 2D arrays

CO4: create programs for manipulating strings

CO5: demonstrate the use of functions and structures to develop applications

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1					3							1
CO2		2	2	2								1
CO3		2	2	2								1
CO4		2	2	2								1
CO5		3	3	3								2

3 – Substantial, 2 – Moderate, 1 – Slight

11EL201 COMMUNICATION SKILLS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Focus on language: Cause and effect expressions - indicators of purpose and function - connectives -imperatives - modal verbs - infinitives and gerunds - reporting verbs - homonyms - commonly confused (mispronounced and misspelt) words - phrasal verbs - British and American Vocabulary.- rules for writing SI [system international] units - concord.

MODULE – II **15**

Listening: Listening practice - Radio / TV news - documentaries - listening to short and long conversations in different domains of activity/ live speech - new inventions, products, announcements, casual conversation, and academic lectures.

Writing: Formal letter writing (letter of application - job application) , Business (calling for quotation, placing orders , letter of complaint) - structure of memorandum and technical reports (reports on visits made to industries, report on an accident in the factory, meeting report) – notices - agenda - instructions - e-mails - Preparing Checklist- note taking and note making.

MODULE- III **15**

Speaking: Communication – accuracy, fluency, appropriateness – levels of formality – oral practice activities related to professional skills – role play using different functions (persuasion, negotiation, giving directions and guidance) – conversational etiquette (greetings, making requests, permission, accepting, denying, declining, politeness strategies, turn-taking, body language) – making speeches – describing people, place, things and events.

Reading: Reading comprehension – guided note- making – providing a suitable title - identifying main points, supporting ideas – evaluating the style (argumentative / descriptive etc) – drawing inferences separating facts from opinions – interpreting text in different genres.

TOTAL : 45

TEXT BOOK

1. Department of Science and Humanities, Anna University, Chennai. “English for Engineers and Technologists”, Combined Edition Volumes (I & II), Orient Longman, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS

1. Kiranmai. Dutt P, Geetha Rajeevan and Prakash, C. L. N., “A Course in Communication Skills”, Cambridge University Press, New Delhi, 2007.
2. Meenakshi Raman and Sangeetha Sharma, “Technical Communication”, Oxford University Press, New Delhi, 2006.
3. Sangeetha Sharma and Binod Mishra, “Communication Skills for Engineers and Scientists”, PHI Learning, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Improve their vocabulary and appropriate usage of words.

CO2: Familiarize with different rhetorical functions of technical English.

CO3: Speak effectively in English in real-life and career-related situations.

CO4: Acquire knowledge in academic and professional writing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1									2	3		1
CO2									2	3		
CO3									1	3		
CO4				1					1	3		1

3 – Substantial, 2 – Moderate, 1 – Slight

11MA201 ENGINEERING MATHEMATICS – II

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Multiple Integrals: Double integration in Cartesian coordinates – Change of order of integration – Area between two curves – Area as double integrals – Triple integration in Cartesian coordinates –Volume as Triple integrals (Simple problems only).

Vector Calculus: Gradient, divergence and curl – Line, surface integral (Concept Only) and volume integrals (Concept Only) – Green's, Gauss divergence and Stoke's theorems (without proof) – Verification of the above theorems and evaluation of integrals using them (Simple problems only).

MODULE – II **15**

Analytic Functions: Functions of a complex variable – Analytic functions – Necessary conditions and Sufficient conditions (excluding proof) – Cauchy– Riemann equations — Properties of analytic function (Statement only) – Harmonic functions – Construction of Analytic functions – Conformal mapping: $w = z + a$, az, $\frac{1}{z}$ - Bilinear transformation.

Complex Integration: Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor and Laurent's series (without proof) – Singularities – Classification – Cauchy's residue theorem (Statement only) – Contour integration – circular and semi-circular contours (excluding poles on real axis).

MODULE – III **15**

Laplace Transforms: Conditions for existence – Transform of elementary functions –Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of unit step function – Transform of periodic functions.

Inverse Laplace transforms: Inverse Transform of elementary functions – Partial fraction method – Convolution theorem (without proof) – Solution of linear ODE of second order with constant coefficients.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy. P, Thilagavathy. K and Gunavathy. K, "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2011, S.Chand and Co., New Delhi.
2. Veerarajan. T., "Engineering Mathematics, (for first year), Reprint Edition 2011, Tata McGraw-Hill New Delhi.

REFERENCE BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Third Edition, Narosa Publishing House, New Delhi, 2007.
3. Bali. N.P and Manish Goyal, "Text Book of Engineering Mathematics", Third Edition, Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify problems involving vectors, double and triple integrals

CO2: Measure the knowledge of analytic functions.

CO3: Evaluate complex integrals which are extensively applied in engineering.

CO4: Adapt Laplace transforms to solve practical problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		1	2							1
CO2	3											1
CO3	3	3		1	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11PH201 MATERIALS SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Crystal Physics: Introduction – Lattice – Unit cell – Crystal systems – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal imperfections : Point, line and surface imperfections.

Conducting Materials: Conductors – Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – Carrier concentration in metals.

MODULE – II **15**

Semiconducting Materials: Intrinsic semiconductor – Carrier concentration derivation – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications - Semiconductor devices – Solar cells - LDR.

Magnetic and Dielectric Materials: Types of magnetic materials – Domain theory – Hysteresis – Soft and hard magnetic materials - Magnetic devices – Transformer core - Magneto optical recording - Dielectric constant - Qualitative study of polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor and transformer) – Ferro electric materials.

MODULE- III **15**

Smart Materials : Metallic glasses: Preparation, properties and applications - Shape memory alloys (SMA): Characteristics, properties, applications, advantages and disadvantages of SMA – Superconductors: Properties – Types of superconductors – BCS theory of superconductivity(Qualitative) - High T_c superconductors – Applications of superconductors – SQUID – cryotron - magnetic levitation.

Nano Materials: Synthesis: Lithographics – Vapour phase physical and chemical deposition methods - Colloidal and solgel methods - Properties of nanoparticles and applications - Carbon nanotubes: Structure – Properties – Fabrication by Laser ablation – Applications.

TOTAL : 45

TEXT BOOKS

1. Kittel. Charles, “Introduction to Solid State Physics”, Seventh Edition, John Wiley & sons, Singapore, 2007.
2. Poole. Charles P and Ownen. Frank J., “Introduction to Nanotechnology”, Wiley India, 2007. (For Module III).

REFERENCE BOOKS

1. Pillai. S O, “Solid State Physics”, Fifth Edition, New Age International, New Delhi, 2003.
2. Rajendran. V, “Engineering Physics”, Prentice Hall of India, New Delhi, 2008.
3. Palanisamy. P K, “Engineering Physics - II”, SciTech publications (India), Chennai 2008.
4. Raghavan. V, “Materials Science and Engineering: A first course”, Fifth Edition, Prentice Hall of India, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Infer the basics of crystal physics and conducting materials.

CO2: Apply the concepts of semiconducting materials, devices, and magnetic and dielectric materials in engineering and technology.

CO3: Interpret the preparation and applications of smart materials and nano materials.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		2						2		1
CO2	3	3		2						2		1
CO3	3	3		2						2		1

3 – Substantial, 2 – Moderate, 1 – Slight

11CY201 ENVIRONMENTAL SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Introduction to Environmental Studies and Natural Resources: Introduction to Environmental Science – Forest resources: Use and over-exploitation, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams - benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture - effects of modern agriculture, fertilizer and pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource – Conservation Practices - Role of an individual in conservation of natural resources. **Ecosystems:** Concept of an ecosystem – Structural features – Functional attributes (Food chain and Food web only) – Introduction, types, characteristic features, structure and functions of the (a) Forest ecosystem (b) Aquatic ecosystems (ponds, rivers and oceans). **Biodiversity:** Introduction to Biodiversity – Definition - genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service value– Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife – Endangered and endemic species of India – In-situ and Ex-situ conservation of biodiversity.

MODULE – II **15**

Pollution: Definition – Causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b) Water pollution (c) Soil pollution (d) Radioactive Pollution - Solid waste Management - Disaster management: floods, earthquake, cyclones and landslides - Role of an individual in prevention of pollution - Case studies. **Water Treatment methods**: Treatment of Water for Domestic Supply (Screening, Aeration, Sedimentation with Coagulation, Filtration and Disinfection methods) - Break point chlorination –Estimation of dissolved oxygen, BOD and COD - Bacteriological examination of water - Sewage treatment (Primary, Secondary & Tertiary methods) - Miscellaneous methods of Sewage treatments (Oxidation Ponds, Aerated Lagoons, Oxidation ditch, Anaerobic Lagoons, Septic tanks) – Methods of Sewage treatment by activated sludge process – Introduction to industrial waste water treatment using Reverse Osmosis Technology- Self purification of Natural Waters - Membrane Technology for wastewater treatment - Activated carbon in pollution abatement of wastewater.

MODULE- III **15**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people - case studies – Environmental ethics - Issues and possible solutions - Wasteland reclamation – Consumerism and waste products – Environment Production Act – Air (Prevention and control of pollution) Act – Water (Prevention and control of pollution) Act – Wildlife protection Act – Forest conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.**Human Population and the Environment:** Introduction - Population growth - Variation of population based on age structure - Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child welfare – Role of Information Technology in Environment and human health – Case studies.

TOTAL : 45

TEXT BOOK

1 Anubha Kaushik, and Kaushik C P, "Environmental Science and Engineering", Third Edition: 2008, (Reprint 2010), New Age International (P) Ltd, New Delhi.

REFERENCE BOOKS

1 B.K.Sharma, **"** Industrial Chemistry",Tenth Edition, Krishna Prakashan Media(P) Ltd,Meerut-250001(UP), India.
2 B Uppal M M revised by S C Bhatia, "Environmental Chemistry", Sixth Edition Khanna Publishers, New Delhi, 2002.
3 Trivedi R.K. and Goel P. K., "Introduction to Air Pollution", Techno-Science Publications, Jaipur, 2003.
4 Masters. Gilbert M, "Introduction to Environmental Engineering and Science", Second Edition, Pearson Education, New Delhi, 2004.
5 Miller, T.G., "Environmental Science", Wadsworth Publishing Co.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Represent the importance of conservation of natural resources and gain the basic knowledge of maintaining ecological balance and conservation of biodiversity

CO2: Comprehend the different types of pollution and waste water treatment methods

CO3: Represent the awareness about making a clean environment and useful environment for the future generations, Consequences of population explosion and Social Issues**.**

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	1	2			1	2	3		3		2
CO2	3	1	2			1	2	3		3		2
CO3	2	2	2			1	2	3		3		2

3 – Substantial, 2 – Moderate, 1 – Slight

11ME101 BASICS OF CIVIL AND MECHANICAL ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

PART-A: CIVIL ENGINEERING

MODULE – I **7**

Construction Materials: Introduction – Civil Engineering – Materials – bricks – stones – sand – cement – concrete – steel sections – Site selection for foundations – Bearing capacity – loads – Types of foundations – requirements.

MODULE – II **7**

Elements of Structures: Superstructure – brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Types of Bridges and Dams.

MODULE - III **8**

Elements of Surveying: Surveying – Objects – types – classification – principles – measurements of distances – Determination of areas –Building area calculation – illustrative examples – Basics of Interior and Landscaping.

PART–B: BASIC MECHANICAL ENGINEERING

MODULE – I Metal Forming and Joining Processes **7**

Foundry: Introduction- patterns – molding –casting - cupola furnace.

Forming: Introduction-Classification- Rolling, extrusion, and drawing.

Welding: Introduction-Classification - TIG, MIG welding, Gas welding, soldering and brazing.

Machining process: Introduction-Classification – lathe and drilling machines.

MODULE – II **8**

Boilers and Power Plants

Steam Boilers: Introduction-Classification- Working Principle of Cochran boiler, Babcock and Wilcox boiler- Benson boiler - Boiler Mountings and accessories. Power Plants: Classification of power plants – working principle of steam, Diesel, Hydro-electric and Nuclear Power plants-Merits and Demerits.

MODULE – III **8**

IC Engines, Refrigeration and Air-conditioning: IC Engines: Classification-components - Working principle of Petrol and Diesel Engines- Four stroke and two stroke cycles- Comparison of four stroke and two stroke engines. Working principle of carburetor, fuel pump and multi point fuel injector. **Refrigeration and Air Conditioning System:** Terminology of Refrigeration and Air conditioning, Properties of refrigerant -Principle of vapour compression and absorption system - Layout of typical domestic refrigerator - Window and Split type room Air conditioner.

TOTAL : 45

TEXT BOOKS

1. Palanichamy, M S., "Basic Civil Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Shanmugam, G, "Basic Mechanical Engineering", 4th Edition, Tata McGraw-Hill, New Delhi, 2011.

REFERENCE BOOKS

1. Rao, M.S., "Basics of Civil Engineering", Dhanpat Rai and Co, New Delhi, 2006.
2. Venugopal, K and Prabhu Raja, V, "Basic Mechanical Engineering", Sixth Edition, Anuradha Publishers, Kumbakonam, 2005.
3. Rao, P N, "Manufacturing Technology: Foundry, Forming and Welding", Tata McGraw-Hill, New Delhi, 2008.
4. Rajan, T.S, "Basic Mechanical Engineering", 3rd Edition, New Age International Publishers, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: select the suitable construction materials and foundation required for a building
CO2: recall the various elements of the super structure
CO3: point out the various elements of surveying and landscaping
CO4: demonstrate the ability to describe the basics of metal forming and joining processes.
CO5: demonstrate the knowledge on patterns, molding, casting, rolling, extrusion, drawing, TIG, MIG welding, gas welding, soldering and brazing.
CO6: describe basics of boilers and power plants.
CO7: explain the working principle of steam, Diesel, Hydro-electric and Nuclear power plants.
CO8: demonstrate the working of IC engines, Refrigeration and Air-conditioning systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2	2	2	2	1						
CO2	3	2	2	2	2	1						
CO3	3	2	2	2	2	1						
CO4	3				2			1				3
CO5	3				2			3				2
CO6	3				2			1				3
CO7	3				3			2				3
CO8	3				2			1				3

3 – Substantial, 2 – Moderate, 1 – Slight

11ME102 ENGINEERING DRAWING

(Common to all Engineering and Technology branches)

2 0 3 3

Concepts (Not for Exam)

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

MODULE – I **15**

Projections of Points, Lines, Planes and Solids:

General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations and location of traces – Projection of polygonal surface and circular lamina inclined to both reference planes. Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

MODULE – II **15**

Sectioning and development of solids:

Sectioning of solids- prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cone with cutout, perpendicular and inclined to the horizontal axis.

15

MODULE- III

Isometric projection, and Perspective projection :

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones

Conversion of isometric projection into orthographic projection. Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL: 45

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V. "Engineering Graphics", New Age International (P) Limited, New Delhi, 2008.
2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD", Tata McGraw Hill, New Delhi, 2008.

REFERENCE BOOKS

1. Bhatt N.D, "Engineering Drawing", 46th Edition, Charotar Publishing House, Anand, 2003.
2. Gopalakrishnana K.R., "Engineering Drawing", Volume. I & II, Subhas Publications, Bangaluru, 2006.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw-Hill, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: prepare elementary sketches of 2D and 3D objects with correct interpretation and mark dimensions properly.

CO2: draw multi-view orthographic and other projections including isometric, sectional, true and perspective.

CO3: read, understand, interpret drawings and communicate effectively.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3				2				3			
CO2	3				2				2			
CO3	3				2				2			

3 – Substantial, 2 – Moderate, 1 – Slight

11PH202 PHYSICAL SCIENCES LABORATORY – II

(Common to all Engineering and Technology branches)

0 0 3 1

PART - A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Determination of band gap of a semiconductor material.
2. Determination of wavelength of mercury spectrum – spectrometer grating.
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4. Determination of hysteresis loss in a ferromagnetic material.
5. Determination of Young's modulus of the material – uniform bending.
6. Determination of viscosity of liquid – Poiseuille's method.

PART - B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Estimation of Chloride in a given water sample.
2. Determination of Dissolved Oxygen in a sample of water / sewage.
3. Estimation of Chromium in Industrial waste water.
4. Estimation of Ferrous ion in rust solution.
5. Estimation of percentage of Copper present in brass.
6. Estimation of ferric ion by Spectrophotometeric method.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Perform experiments on semiconductors, thermal conductivity, optics, elasticity, viscosity of liquids.

CO2: Understand the concepts of wavelength, band gap, thermal conductivity, Young's modulus and viscosity.

CO3: Get a knowledge about the estimation of DO, chloride, chromium, ferrous ion and copper in wastewater.

CO4: Get an idea about the estimation of iron in unknown solution using spectrophotometer.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		2						1		1
CO2	3	3		2						1		1
CO3	3	2		2						3		3
CO4	3	2		2						3		3

3 – Substantial, 2 – Moderate, 1 – Slight

11ME103 ENGINEERING PRACTICES LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: CIVIL & MECHANICAL

LIST OF EXPERIMENTS

1.FITTING

Tools & Equipments – Practice in Filing and Drilling.

Making Vee Joints, Square, dovetail joints, Key Making.

2. PLUMBING

Tools & Equipments - Pipe connection for a bath room, Pipe connection for multi-storey building,

Pipe connection with different components like valves, tap, coupling, union, reducers, elbows etc.

Plumbing work with metal, PVC and flexible hoses (Threading, joining of pipes)

3.CARPENTRY

Tools and Equipments- Planning practice. Making Half Lap, dovetail, Mortise & Tenon joints, a mini model of a single door window frame.

Making of Pen stand, Box, etc. from plywood. (Use of modern power tools for cutting)

4.SHEET METAL

Tools and equipments - Fabrication of a small cabinet, Rectangular Hopper, etc.

5.WELDING

Tools and equipments - Arc and Gas welding of butt joint, Lap Joint and Tee Fillet.

REFERENCES / MANUALS / SOFTWARE:

1. Suyambazhahan, S, "Engineering Practices Laboratory Manual", PHI Learning, NewDelhi, 2010.
2. John, K. C., "Mechanical Workshop Practice", Second Edition, PHI Learning, NewDelhi, 2009.

PART-B: ELECTRICAL & ELECTRONICS

1. Safety aspects of Electrical wiring.
2. Wiring circuit for a lamp using single and two way switches (stair case).
3. Wiring circuit for fluorescent lamp.
4. Study of Electronic components and equipment – Resistor-colour coding, measurement of AC Signal parameter (Peak-Peak, RMS Value, Frequency and Power factor) using CRO
5. Assembling electronic components on a small PCB (Etching, Fabrication and Testing)
6. Measurement of earth resistance and insulation resistance of an electrical equipment
7. Study of Telephone, FM radio & Transducers.
8. Study of Mixie, Iron box, Ceiling & Table Fans.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the functions of different tools used in fitting, carpentry, sheet metals and welding.

CO2: prepare different types of joints in metal pieces, sheet metals and wooden pieces.

CO3: plan and fabricate simple models.

CO4: utilize the basic laboratory equipment

CO5: build the layout of domestic wiring circuits and troubleshoot it.

CO6: estimate Earth Resistance, assemble electronic components in PCB and understand operation of various domestic appliances

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2							2			1	
CO2	2							3			2	
CO3	3							2			2	
CO4	3		1		3						2	3
CO5	3	2			2	3						3
CO6	3					2						3

3 – Substantial, 2 – Moderate, 1 – Slight

11EL202 COMMUNICATION SKILLS LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS

English Lab

1. Listening Comprehension

   Listening to instructional software packages in the communication laboratory, using them, understanding the mechanics of language like grammar, listening to native speakers' presentation, and developing oral communication by imitating the model dialogues. Listening for specific information – listening to improve pronunciation – Listening and typing – Filling the blanks – TV programmes and News.

2. Reading comprehension and vocabulary:

   Reading for getting information and understanding; scanning, skimming and identifying topic sentences – reading for gaining knowledge, looking for transitions, understanding the attitude of the writer – Filling the blanks – Cloze exercises – vocabulary building – Comprehension.

3. Speaking:

   Group discussion; verbal and non-verbal communication; speaking on situational topics – maintaining eye contact, speaking audibly, clearly and with confidence – Common errors in English

   Conversations – face-to-Face conversation – Telephone Conversation – Roll play.

4. Writing Skills:

   Writing job application: resume, applications for jobs, making complaint letters – Projects: report writing – editing and proof reading – research paper and translating numerical data from charts and diagrams into verbal communication.

Career Lab

1. Letter Writing / Resume / Report preparation:
   Structuring Letter Writing / Resume / Report preparation / E-Mail
2. Presentation skills
   Elements and structure effective presentation – presentation tools – voice Modulation – Body language – Video samples
3. Group Discussion
   Structure of Group Discussion – Strategies in GD – Team work – Video Samples
4. Interview skills
   Kinds of Interview- corporate culture – video samples
5. Soft Skills
   Time management – stress management – assertiveness – case study

Communication Software Package:

a. Presentation Skills
b. Interview Skills
c. Group Discussion

- From Globarena Software

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Write, read and listen English effectively
CO2: Communicate efficiently in English in real life and career related situations
CO3: Demonstrate good presentation skill.
CO4: Use the modern communication software package to enhance the soft skills

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1				2					2	3		1
CO2				2					2	3		1
CO3				2					2	3		1
CO4									2	3		

3 – Substantial, 2 – Moderate, 1 – Slight

11MA301 ENGINEERING MATHEMATICS – III

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Fourier Series: Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Change of interval - Parseval's Identity - Harmonic analysis.

MODULE - II **15**

Partial Differential Equations: Formation – By elimination of arbitrary constants and arbitrary functions – Standard types– Lagrange's linear equation- Linear partial differential equations of second order with constant coefficients.

Applications of Partial Differential Equations: Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded).

MODULE - III **15**

Fourier transform: Fourier integral theorem (Statement only) – Fourier transform pair – Properties – Transforms of simple functions – Sine and Cosine transforms – Convolution theorem and Parseval's identity (Statement only).

Z-transform: Elementary properties – Transforms of simple functions - Inverse Z – transform(Partial Fraction Method and Residue method) – Convolution theorem (Statement Only) – Solution of Difference Equations.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics", Volume - III, S. Chand & Co, New Delhi, 2008.
2. Veerarajan, T., "Engineering Mathematics", Tata McGraw-Hill, New Delhi, Reprint 2010.

REFERENCE BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers, New Delhi, 2007.
2. Wylie, C. Ray and Barrett, Louis, C., "Advanced Engineering Mathematics", Sixth Edition, McGraw-Hill, New York, 2004.
3. Andrews, L. A. and Shivamoggi, B. K., "Integral Transforms for Engineers and Applied Mathematicians", Macmillan, New York, 2004.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Utilize Fourier series to solve engineering problems.

CO2: Formulate and solve higher order partial differential equations.

CO3: Interpret the basic knowledge of Fourier transforms and Z-transforms in engineering field.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		1	2							1
CO2	3	3		2	2							1
CO3	3	3		1	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT301 FLUID MECHANICS FOR FOOD TECHNOLOGIST

3 1 0 4

MODULE– I **15**

Fluid Statics and Basic Equations of Fluid Flow

Fluid Statics: Nature of fluids – physical properties of fluids, Compressible and incompressible. Types of fluids – Newtonian and Non – Newtonian fluids. Units and dimensions, Conversion of units, Basics of dimensional analysis: Rayleigh's method, Bukingham's π Method. Fluid static: Hydrostatic equilibrium. Application of fluid statics: manometers, continuous gravity decanter. **Basic Equations of Fluid Flow:** Kinematics of fluid flow, Concept of boundary layer. Basic equation of fluid flow: Equation of continuity and Bernoulli equation. Correction of Bernoulli equation for fluid friction. Application of Bernoulli equation for pump work

MODULE - II **15**

Fluid Flow Phenomena and Agitation of Liquids:

Fluid Flow Phenomena: Shear stress and skin friction in pipes. Laminar and turbulent flow of fluids through closed conduits. Velocity profiles and friction factor for smooth and rough pipes. Friction loss due to sudden enlargement, contraction. Friction loss in fittings, valves, coils. Pressure drop for flow of liquids through porous media. **Agitation of Liquids:**Motion of particles through fluids: Equation for one dimensional motion of spherical particle through fluid, terminal velocity, Hindered settling. Agitation of liquids: Types of impellers, Flow pattern in agitated vessel. Power consumption in agitated vessels, blending and mixing

MODULE- III **15**

Transportation and Metering of Fluids:

Transportation: Pipe, fittings and valves. Pumps: Performance of Positive displacement pumps and centrifugal pump. Principles and application: vacuum pump, metering pump, peristaltic pump. Fans, blowers and compressors: types and applications. **Metering of Fluids:** Variable head meter: Orifice meter, Venturi meter, Pitot tube. Variable area meter: Rota meter. Calibration of flow meters. Principles and applications of Doppler Effect in flow measurement. Principle of Magnetic flow meters, V-Notch, Turbine flow meters, and Thermal flow meters.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

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

REFERENCE BOOKS

1. Coulson, J.M., and Richardson, J.F., "Chemical Engineering", Volume - I, Pergamon Press, New York, 1977.
2. Cengel, Yunus A. and Cimbala, John M., "Fluid Mechanics Fundamentals and Applications", Tata McGraw–Hill, New Delhi, 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify the fundamental concepts of fluids and fluid flow properties and apply to hydrostatic and fluid flow problems.

CO2: Analyze fluid flow through pipes and select suitable mixing equipment used in industries.

CO3: Select and evaluate the performance of pumps, flow meter(s) and valves

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2	2									1
CO2	3	2	3									1
CO3	3	2	3									1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT302 FOOD PROCESS CALCULATIONS

3 1 0 4

MODULE - I **15**

Units and Dimensions: Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws – Gas constant - calculations of pressure, volume and temperature using ideal gas law. **Fundamental Calculations and Humidity:** Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation. Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

MODULE - II **15**

Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching. **Combustion:** Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air.

MODULE - III **15**

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

Lecture: 45, Tutorial: 15, TOTAL: 60

(Use of Psychometric chart is permitted in the examination)

TEXT BOOKS

1. Bhatt, B.L and Vora, S.M., "Stoichiometry", Third Edition, McGraw-Hill, New York, 1996.
2. Gavhane, K.A "Introduction to Process Calculations (Stoichiometery)" Nirali Prakashan Publications, Pune, 2006.

REFERENCE BOOKS

1. Venkataramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India, New Delhi, 2003.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition, Prentice Hall India, New Delhi, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Solve different systems of Units and dimensions, estimate compositions of mixtures, solutions and fundamentals of humidity.

CO2: Apply material balance for different unit operations and acquire knowledge on combustion of fuels.

CO3: Make use of the concepts on energy balance and enthalpy.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3	2	1	1							1
CO2	3	3	3	1	1							1
CO3	3	3	2	1	1							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT303 ENGINEERING PROPERTIES OF FOOD MATERIALS

3 0 0 3

MODULE – I **15**

Physical Properties: Physical properties of food materials- size, shape, density, porosity and surface area – definitions and measurements, moisture content and its determination, direct and indirect methods, units, Frictional properties - friction – types, coefficient of friction, angle of repose - types and its determination. **Aero and Hydrodynamic Properties:** Aerodynamic properties, drag coefficients, hydrodynamic properties, Properties of fluids, surface tension, diffusion, osmosis, osmotic pressure, Reverse osmosis, separation techniques using membranes and applications.

MODULE - II **15**

Thermal Properties: Thermal properties, Definitions, specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Measurement of specific heat, thermal conductivity, thermal diffusivity. Cryogenics, Calorific value of food, Bomb calorimeter. Applications. **Optical Properties:** Refractive index of food items, Abbe's refractometer, Sorting of using optical properties , Optical activity, Polarimeter, Spectrophotometer, Gloss, color, translucency – Definitions, measurement and applications.

MODULE - III **15**

Electromagnetic Properties: Electrical properties, Dielectric properties, dielectric constant, dielectric heating, electrical conductivity, dielectric measurements, microwave heating and other Applications. **Rheological Properties**: Rheology – flowchart, Stress-strain relationships in solids, liquids and viscoelastic materials, stress-strain diagrams, Emulsions and Colloids. Viscosity – principle, types, and types of viscometers. Texture – types of food textures and its measuring instruments. Properties of food powders.

TOTAL : 45

TEXT BOOKS

1 Rao, M. A. and Rizvi, S. S. H., "Engineering Properties of Foods", Mercel Dekker Inc. New York, 1998.
2 Mohesnin, N.N., "Physical Properties of Plant and Animal Materials", Volume. I, Gordon and Breach Science Publishers. New York, 1970.

REFERENCE BOOKS

1 Stroshine, R., "Physical Properties of Agricultural Materials and Food Products", West Lafayette, IN., Purdue University, 2000.
2 Mathur, D.S., "Properties of Matter", S.Chand & Co, New Delhi, 1997.
3 Singh, R. Paul and Heldman, Dennis R., "Introduction to Food Engineering", Third Edition, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Assess the physical, aero and hydrodynamic properties of food materials.

CO2: Estimate the Thermal and Optical properties of food materials.

CO3: Intrepret the electromagnetic and Rheological properties of food materials.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2		1	2							
CO2	3	2		2	2							
CO3	3	2		2	2							

3 – Substantial, 2 – Moderate, 1 – Slight

11FT304 FUNDAMENTALS OF BIOCHEMISTRY

3 0 0 3

MODULE – I **18**

Carbohydrates : Classificatin; Simple Sugars: mono and disaccharides, Hygroscopicity & solubility, optical rotation, mutarotation; sensory properties-sweetness index, Dextrose Equivalent, Degree of polymerisation; Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence. Polysaccharides: Starch- amylose and amylopectin- properties. Pectins, gums & seaweeds. Dietary fibres - Food sources, functional role and uses in foods.

Lipids: Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, isomerisation, unsaturation; Hydrolytic rancidity & oxidative rancidity; radiolysis. Shortening power of fats, tenderization, emulsification, frying- smoke point, autooxidation, polymerization; Food sources, functional role.

MODULE - II **12**

Proteins: Aminoacids-Definition, structure and classification. Review of protein structure & conformation; Properties & reactions of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation &stabilization, gel formation, emulsifying effect. denaturation Food sources, functional role and uses in foods.

Enzymes: Introduction, Nature, Function, classification & nomenclature of enzymes. Specificity. Enzyme kinetics - Factors affecting enzyme action, mechanism of enzyme action; active site. Enzymes as food processing aids. Immobilization methods.

MODULE - III **15**

Nucleic Acids Nucleic acids – composition and structure of DNA and RNA. **Minerals** Minerals – major-Ca,K,Na,P and minor minerals-Fe Zn, Se, I, Cu and their functional role.

Vitamins Vitamins - Definition, classification, general sources, structure, properties, functions and deficiency symptoms of water soluble and fat soluble vitamins.

TOTAL : 45

TEXT BOOKS

1 Jain,.J.L., “Fundamentals of Biochemistry”, Fourteenth Edition, S.Chand & Co, New Delhi, 1999.

2 Belitz, H. D., Grosch, W., Schieberle,P. “Food Chemistry”, Third Edition, Springer-Verley, Berlin, 2004.

REFERENCE BOOKS

1 Voet, D and Voet, G., “Biochemistry”, Second Edition, John Wiley and Sons, New York, 1994.

2 Zubay,G., “Biochemistry”, Second Edition, Maxwell Macmillan International London, 1987.

3 Conn, E and Stump, P.K., “Outlines of Biochemistry”, Willey Eastern Ltd., New Delhi, 1984.

4 Robinson, David S., “Food Biochemistry and Nutritive Value”, Longman Group, London, 1987.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Categorize the structure and properties of carbohydrates and lipids

CO2: Assess the structural and functional role of proteins, enzymes and its applications.

CO3: Identify the structure of nucleic acids and appraise the nutritional importance of vitamins and minerals.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2	2	2		1						1
CO2	3	2	2	2		1						1
CO3	3	1	1	2		1						

3 – Substantial, 2 – Moderate, 1 – Slight

11FT305 PRINCIPLES OF MICROBIOLOGY

3 0 0 3

MODULE – I **15**

Introduction To Microbiology: Development and Scope of Microbiology – History of Microbiology - Spontaneous generation theory – Germ theory of diseases – Contributions by Anton Van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Joseph Lister, Winogradsky, Beijerinck, Alexander Fleming and Waksman - Classification and Identification of Microorganisms. Groups of microorganisms - Prokaryotes and Eukaryotes. Microbial cell - structure Bacterial morphology, reproduction. Algae, Fungi, Viruses - Bacteriophages - Importance.

Microorganisms: Microscopy – Principles – resolution – numerical aperture, magnification - Different types of microscopes - Light microscopes - UV, dark field, phase contrast, Electron microscope (Scanning – Transmission type).

MODULE - II **15**

Microbial Growth, Isolation: Factors influencing the Bacterial growth - Growth curve – continuous culture, Synchronous culture, Chemostat. Life cycle – Lytic and Lysogenic types – Importance. Staining techniques – Simple, differential and structural staining.

Metabolism: Methods of Isolation and Purification – pure culture technique – Primary nutritional groups - nutritional requirements, Preparation of Media – types of nutritional media. Introduction to Metabolism, Energy production by aerobes, anaerobes, photosynthetic organisms - Glycolysis, Fermentation, Anaerobic Respiration.

MODULE - III **15**

Microbial Genetics, Diseases: Microbial genetics – Mutationand their frequency –Spantaneous, silent and reversion, Types and induction- point and frame shift.Gene transfer mechanism - Conjugation, Transformation and Transduction. Disease transmission through Air, water and Food.

Control: Antimicrobial action, mode of action of antimicrobial agents - Physical agents, chemical agents - Antibiotics. Immunology - Principles – Antigen and antibody reaction. Microbial products and Industrial application of microorganisms.

TOTAL : 45

TEXT BOOKS

1 Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., “Microbiology”, McGraw-Hill, New York, 2004.
2 Powar, C.B. and Daginawala, H.F., “General Microbiology”, Volume I and II, Himalaya Publishing House, New Delhi, 2005.

REFERENCE BOOKS

1 Rangaswami, G and Bagyaraj, D.J., “Agricultural Microbiology”, Asia Publishing House, New Delhi, 1992.
2 Stanier, R.Y., Ingtaham, J., Wheelis, M.C., and Painter, P.R., “The Microbial world”, Prentice Hall, England, New Jersey, 1986.
3 Tauro,P, K.K. Kapoor and K.S. Yadav, “An Introduction to microbiology”. Wiley Publications, New Delhi, 1989.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Infer knowledge on historical developments, structure of microorganisms and principles of microscope.

CO2: Apply fundamental knowledge on microbial growth, isolation and metabolism

CO3: Appraise the importance of microbial genetics, sources of disease and its control measures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1										
CO2	3	2		2								
CO3	3	2	1			1						1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT306 UNIT OPERATIONS LABORATORY - I

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Venturimeter
2. Orficemeter
3. Pitot Tube
4. Viscosity measurements of Non – Newtonian fluids
5. Flow through coils
6. Characteristic curves of centrifugal pumps
7. Flow through square duct pipes
8. Flow through circular pipes / packed beds
9. V- Notch
10. Flow through annular pipes
11. Sedimentation
12. Flow through valves and pipe fittings

REFERENCES / MANUALS/SOFTWARE:

McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations of Chemical Engineering", Seventh Edition, McGraw-Hill, New York, 2005.

Perry Robert, "Perry's Chemical Engineers Hand book", Eight Edition, McGraw-Hill, New York, 2007

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Determine the discharge coefficient using variable area flow meters and variable head flow meters

CO2: Assess the flow of fluids through closed conduits, open channels, valves and pipe fitting

CO3: Select pumps for the transportation of fluids and calculate the area of the thickener.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	1		3					3			1
CO2	2	1		3					3			1
CO3	2	1		3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT307 BIOCHEMISTRY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS/EXERCISES

1. Qualitative tests for monosaccharide, disaccharides, polysaccharides
2. Estimation of reducing sugar by dinitrosalicylic acid method
3. Estimation of starch
4. Determination of iodine number
5. Extraction of oil and estimation of oil content
6. Determination of Saponification number
7. Estimation of ash and acid insoluble ash.
8. Estimation of vitamin C
9. Estimation of protein
10. Estimation of iron.

REFERENCES / MANUALS/SOFTWARE

Sadasivam, S., and Manickam, A., "Biochemical Methods", Third Edition, New Age International, Delhi, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify and estimate the carbohydrates in food samples.

CO2: Extract and determine the chemical constants of oil

CO3: Estimate protein, vitamin and minerals in food samples

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	3		3		1			3			1
CO2	2	3		3		3			3			1
CO3	2	3		3		2			3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT308 MICROBIOLOGY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS/ EXERCISES

1. Sterilization techniques and equipments
2. Preparation of different culture media
3. Techniques for isolation of pure culture
4. Wet mount preparation and Hanging Drop Technique
5. Simple staining
6. Gram staining
7. Cultivation and enumeration of microorganisms
8. Distribution of microorganisms in nature
9. Purification of bacteria and fungi
10. Assessing the load of coliform bacteria as indicator organisms
11. Biochemical activities of microorganisms
12. Antimicrobial activity of microorganisms

REFERENCES / MANUALS/SOFTWARE:

Gunasekaran, P., "Laboratory manual in microbiology" First Edition, New age International Publictions, Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Distinguish the microorganisms by staining techniques.

CO2: Appraise the methods to enumerate the microorganisms

CO3: Analyse the different activities of microorganisms

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2		1					3			1
CO2	2	3		2					3			1
CO3	2	3		1					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11MA401 NUMERICAL METHODS

(Common to all Engineering and Technology branches except ECE & CSE)

3 1 0 4

MODULE - I **15**

Linear Algebraic Equations: Method of false position - Newton's method - Solution of linear system of equations by Gaussian elimination and Gauss - Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods.

Interpolation: Newton's forward and backward difference formulae – Bessel's formula - Lagrange's interpolation formula - Newton's divided difference formula.

MODULE - II **15**

Numerical Differentiation: Differentiation Using Newton's forward , backward and divided difference interpolation formula - Single step Methods - Taylor Series, Euler and Modified Euler methods - Fourth order Runge-Kutta method for solving first order equations - Multistep methods – Milne's and Adam's predictor and corrector methods.

Numerical Integration: Trapezoidal rule – Simpson's 1/3 – Double integrals using Trapezoidal and Simpson's rules.

MODULE - III **15**

Boundary Value Problems in PDE: Finite difference approximations to partial derivatives - Two dimensional Laplace equations - Poisson equations – One dimensional heat equation by implicit and explicit methods – One dimensional wave equation.

Lecturer: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy, P., Thilakavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand & Co, New Delhi, reprint 2010.
2. Venkatraman, M. K, "Numerical Methods", National Publishing Company, Chennai, 2000.

REFERENCE BOOKS

1. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill, New Delhi, 1999.
2. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", Fourth Edition, New Age International (P) Ltd., New Delhi, 2006.
3. Sankara Rao, K., "Numerical Methods for Scientists and Engineers", Second Edition, Prentice Hall India, New Delhi, 2004.
4. Thangaraj, P, "Computer – Oriented Numerical Methods", Prentice Hall of India, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Discuss the various methods of solving linear algebraic and transcendental equations.

CO2: Estimate the intermediate values using interpolation concepts.

CO3: Interpret the knowledge of numerical differentiations and integration

CO4: Apply various numerical techniques in solving complex partial differential equations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		1	2							1
CO2	3	3										1
CO3	3	3		1	2							1
CO4	3	3		1	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT401 APPLIED THERMODYNAMICS

3 1 0 4

MODULE - I **15**

Basic Concepts Thermodynamics: Fundamental concepts of thermodynamics- microscopic and macroscopic approach – systems, properties, process, functions, units, energy, heat and work, Zeroth law.

First Law of Thermodynamics: First law - statement of first law for flow and non flow process, internal energy, enthalpy, heat capacities (C_V and $C_{P)}$ – steady flow processes with reference to various thermal equipments - nozzle, throat, throttling process and compressors.

MODULE - II **15**

Second Law of Thermodynamics: Second Law of thermodynamics – statements, equivalents of Kelvin-Plank and Clausius statements, reversible cycle – Carnot cycle and theorem – thermodynamic temperature scale. Entropy, Clausius theorem, Clausius inequality, Entropy changes during processes.

Properties of Pure Substances and Formulation: Properties of ideal and real gases, Air standard cycles – Otto, diesel and dual cycle. Phase rule, P-V, P-T, T-S, H-S Diagrams, PVT surfaces.

MODULE - III **15**

Steam Properties: Properties of steam, steam tables, Mollier chart, Psychrometry, Basic Principles of Psychrometry, psychrometric chart. Determination of dryness fraction of steam - Different types of calorimeters. Concept of steam distribution systems. Types of steam traps and their characteristics. Efficient utilization of steam in food process industries.

Boilers: Types and classification of boilers, Cochran Boiler, Lancashire boiler, locomotive boiler, fluidized bed boiler; Boiler mountings and Accessories. Performance and energy efficiency of boilers. Simple calculation of Boiler efficiency. Importance of boiler water treatment and blow down.

Lecture: 45, Tutorial: 15, TOTAL: 60

(Use of standard steam tables, Mollier diagram, Psychometric chart are permitted in the examination)

TEXT BOOKS

1. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, New Delhi, 2003.
2. Ballaney, P.L. "Thermal Engineering", Twenty Third Edition, Khanna Publishers, New Delhi, 2003.

REFERENCE BOOKS

1. Smith, J M., Van Ness, H C and Abbott, M M., "Introduction to Chemical Engineering Thermodynamics", Seventh Edition, McGraw-Hill, New York, 2005.
2. Kothandaraman, C.P., Khajuria, P.R., Arora, S.C and Domkundwar, S.A "Course in Thermodynamics and Heat Engines", Third Edition, Dhanpat Rai & Sons, New Delhi,1990

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline the basic concepts and apply the first law of thermodynamics in selected processes.

CO2: Interpret the second law of thermodynamics and relate the properties of pure substance

CO3: Estimate the properties of steam and classify the boilers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1	1									
CO2	3	2	2		1							
CO3	3	2	2		2							2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT402 HEAT TRANSFER IN FOOD PROCESSING OPERATIONS

3 1 0 4

MODULE - I **15**

Conduction: Concept of heat conduction - Fourier's law of heat conduction -, -one dimensional steady state heat conduction equation for flat plate, hollow cylinder - Heat conduction through a series of resistances- thermal conductivity and its measurement –effect of temperature on thermal conductivity.

Film Coefficients: Individual and overall heat transfer coefficients and the relationship between them - Conduction with heat source -extended surface heat transfer - Transient heat conduction.

MODULE - II **15**

Convection: Concept of heat transfer by convection - Natural and forced convection –Combined natural and forced convection - Application of dimensional analysis for convection - Equations for forced and natural convection under laminar, transition and turbulent conditions.

Radiation: Concept of thermal radiations - Black body concept - Radiation Properties – Stefan Boltzman's law, emissivity and absorptivity. -Concept of grey body – radiation between surfaces – radiation shields.

MODULE - III **15**

Heat Exchangers: Parallel and counter flow heat exchangers -. LMTD - Heat exchangers effectiveness; number of transfer unit – use of correction factor charts, Chart for different configurations - Fouling factor.

Evaporators: Types of heat exchanger- Single pass, multipass heat exchangers, shell and tube heat exchanger, plate heat exchangers. Types of evaporator-Single effect and Multiple effect evaporator.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kern. D.Q., “Process Heat Transfer", McGraw-Hill, New York, 1999.
2. Dutta. Binay K. "Heat Transfer: Principles and Applications", Prentice Hall of India, New Delhi, 2001.

REFERENCE BOOKS

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations of Chemical Engineering”, Seventh Edition, McGraw-Hill, New York, 2005.
2. Cengel. Yunus A.., "Heat Transfer: A Practical Approach", Second Edition, WCB/McGraw-Hill, New Delhi, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the concept of heat conduction in food Processing and estimate the film coefficients for steady and unsteady state of heat transfer.

CO2: Make use of the dimensional analysis in solving convectional problems and recall the concepts of radiation.

CO3: Illustrate the principle and operations of heat exchangers and evaporators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2		2	1							1
CO2	3	2		2	2							1
CO3	3	2	2	2	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT403 MASS TRANSFER FOR FOOD TECHNOLOGIST

3 1 0 4

MODULE – I **15**

Diffusion and Mass Transfer Co-Efficient:

Diffusion: Types of mass transfer operations, Ficks law of diffusion. Steady state molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions.

Mass Transfer Co-Efficient: Measurement and prediction of diffusivity of gas and liquids, diffusion in solids. Basic concept of mass transfer: local and over all mass transfer co-efficient. Interphase mass Transfer

MODULE - II **15**

Humidification and Distillation:

Humidification: Basic concepts and terminologies, Adiabatic saturation process and theory of wet bulb temperature, psychrometric chart construction. Measurement of humidity by dew point, wet bulb methods. Cooling towers: Principle and operation.

Distillation: Vapour-liquid equilibria, Raoult's law and deviations from ideality. Methods of distillation: Simple distillation- calculations using Rayleigh equation, Flash vaporization, steam distillation. Design of multistage tray towers for binary systems using McCabe-Thiele method.

MODULE - III **15**

Liquid-Liquid Extraction and Leaching:

Liquid-Liquid Extraction: Equilibrium in ternary systems; Solvent selection criteria; equilibrium stage wise contact – Single stage extraction, Multi stage cross current, Basics of continuous counter current multistage Extraction. Extractor - Stage and continuous: Principle and operation

Leaching: Solid-liquid equilibria; basics of single stage leaching, multi stage crosscurrent and counter current leaching operations. Leaching equipment-batch and continuous types: Principle and operation.

Lecture:45, Tutorial: 15, TOTAL : 60

(Use of Psychometric chart is permitted in the examination)

TEXT BOOKS

1. Treybal. R.E., "Mass Transfer Operations", Third Edition, McGraw-Hill, New York, 1981.
2. Gavhane, K.A., "Mass Transfer - II", Fifth Edition, Nirali Prakashan Publications, Pune, 2006

REFERENCE BOOKS

1. Foust. A.S. Wenzel. L.A., Clump. C.W., Naus. L. and Anderson. L.B., "Principles of Unit Operations", Second Edition, John Wiley & Sons, New York, 1980.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations of Chemical Engineering", Seventh Edition, McGraw-Hill, New York, 2005.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline the diffusion phenomena and estimate the mass transfer coefficient

CO2: Apply the concepts of humidification and distillation process in food processing operations

CO3: Select and illustrate the extraction and leaching process

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2	1	1								1
CO2	3	3	3	3	2							1
CO3	3	3	3	3	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT404 BIOCHEMISTRY OF PROCESSING AND PRESERVATION OF FOODS

3 0 0 3

MODULE- I **15**

Food Science and Nutrition: Food Science - Definition. Major food groups and their characterization. Food as a source of energy, Energy value of foods, energy requirement of the body-estimation. Water – Role of water –Physical properties of water - concept of water activity – Water binding in foods. Nutrition – definition. Concepts of malnutrition and under nutrition. Balanced diets – Recommended Dietary Allowances (RDA) for various age groups. Nutritional deficiency disorders.

Metabolism: Metabolism- Glycolysis; TCA cycle. Cellular respiration- electron transport chain. Lipid metabolism – lipases and phospholipases. Fatty acid metabolism – beta oxidation and fatty acid synthesis.

MODULE-II **15**

Changes During Cooking: Cooking – methods, biochemical changes in carbohydrates, proteins and lipids during cooking; parboiling of rice; caramelization of sugars, enzymatic and non enzymatic browning reactions. Loss of nutrients and prevention of loss during cooking.

Modification of Biomolecules: Gelatinization and retro gradation of starch. Modified starches, resistant starch. Starch hydrolysates – Malto dextrins and dextrins. Modification of proteins. Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization.

MODULE- III **15**

Secondary Metabolites: Food colours – natural and synthetic colours. Sensory perception of flavours and specific flavours. Chemistry of aroma compounds. Essential oils, organic acids, oleoresin, alkaloids.

Food Additives - classification and purpose - Role of thickeners, sweeteners, stabilizers, emulsifiers, leaveners, colours, flavoring agents, flour improvers, anticaking agents, sequestrants, humectants, preservatives - examples.

Changes During Preservation: Biochemical changes during preservation by Low and High temperature. Biochemical changes during processing of foods-pickling, malting, drying, baking.

TOTAL : 45

TEXT BOOKS

1. Belitz, H. D., Grosch, W., Schieberle,P. “Food Chemistry”, Third Edition, Springer-Verley, Berlin, 2004.
2. Srilakshmi, B., “Food Science”, New Age International Publishers, Chennai, 2001.

REFERENCE BOOKS

1. Fennema, Owen R., “Food Chemistry”, Third Edition, Marcel-Dekker, New York, 1996.
2. Miller, Dennis D., “Food Chemistry”, John Wiley & Sons, New York, 1993.
3. Raheena Begum. “A Text book of foods, nutrition and Dietetics”. Sterling Publishers Private Ltd. New Delhi, 2001.
4. Eskin, N. A. and Henderson, H. M., “Biochemistry of Foods”, Harcourt Publishers Ltd, Singapore, 1990.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Illustrate the basics of food science, nutrition and energy metabolism.

CO2: Interpret the changes during cooking and modification of biomolecules.

CO3: Appraise the importance of secondary metabolites, food additives and predict the changes during preservation of foods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2	2			2						1
CO2	3	2	1			1						1
CO3	3	2	2			2		1				1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT405 FOOD MICROBIOLOGY

3 0 0 3

MODULE – I **15**

Incidence of Microorganisms in Food Importance of microorganisms in food – primary sources of microorganisms in food – Intrinsic and Extrinsic parameters of food affecting microbial growth – Types of microorganisms in foods like meats, poultry, seafood, vegetables, dairy products, fruits and vegetables.

Load Assessment: Microorganisms as food – single cell protein –Bacteria, Algae, Fungi. Probiotics. Assessing microbial load in foods – microscopic, cultural, physical, chemical and immunological methods.

MODULE – II **15**

Microbial Spoilage: Spoilage of foods – principles and types of spoilage – microbial spoilage of different types of foods, - spoilage of fruits and vegetables, fresh and processed meats, poultry, seafoods, cereals products, bakery products, dairy products, fermented foods and canned foods.

Food Preservation: Food preservation – principles – Factors affecting preservation – Food preservation using temperature – low temperature food preservation – high temperature food preservation – characteristics of psychrotrophs and thermophiles – preservation by drying, chemicals and radiation.

MODULE– III **15**

Food Sanitation Food sanitation – indicators of food safety – Coliform bacteria. Food borne infections and food poisoning – botulism – salmonellosis – gastroenteritis.Food borne pathogens – Clostridium perfrigenes, Vibrio, Campylobacter.

Indicator Organisms: Food processing plant sanitation – microbiological standards and guidelines – microbial quality control and food laws, Microbiological criteria for foods, Enforcement and control agencies.

TOTAL : 45

TEXT BOOKS

1. Frazier, W.C. and Westhoff, “Food Microbiology”, Tata McGraw-Hill, New Delhi, 1988.
2. Jay, J.M., “Modern Food Microbiology”, CBS Publishers & Distributors, New Delhi, 1996.

REFERENCE BOOKS

1. Gould, G.W., “New Methods of Food Preservation”, Blackie Academic & Professional, London, 1996.
2. King, R.D. and Cheetham, P.S.J.., “Food Biotechnology”, Elsevier Applied Science, New York, 1986.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify the sources and factors influencing the microbial growth and assess the microbial load.

CO2: Inspect and infer microbial spoilage of foods and preservation methods.

CO3: Perceive the importance of food sanitation and microbiological standards.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1										
CO2	3	2	1			2						1
CO3	3	2	1			3	1	1				1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT406 UNIT OPERATIONS LABORATORY - II

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Shell and tube heat exchangers
2. Heat transfer in natural convection
3. Stefan Boltzman constant
4. Single effect evaporator
5. Heat transfer in an agitated vessel
6. Heat transfer in bare and fin tubes
7. Simple Distillation
8. Leaching
9. Tray dryer
10. Diffusivity measurements
11. Liquid – liquid extraction
12. Steam distillation / Packed bed distillation

REFERENCES / MANUALS/SOFTWARE:

McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations of Chemical Engineering", Seventh Edition, McGraw-Hill, New York, 2005.

Treybal. R.E., "Mass Transfer Operations", Third Edition, McGraw-Hill, New York, 1981.

Perry Robert, "Perry's Chemical Engineers Hand book", Eight Edition, McGraw-Hill, New York, 2007

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Evaluate the process/performance parameters for mass transfer operations (distillation column, leaching and drying)

CO2: Determine diffusivity and Stefan Boltzman constant using fundamental principles.

CO3: Calculate the individual and overall heat transfer coefficient of heat exchangers.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2	1	3					3			1
CO2	2	1		3					3			1
CO3	2	2	1	3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT407 FOOD CHEMISTRY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS/EXERCISES

1. Estimation of moisture content
2. Estimation of crude fibre
3. Isolation of starch from tubers
4. Extraction and estimation of Chlorophyll
5. Extraction and estimation of Carotenoids and lycopene
6. Isolation of protein from milk and egg
7. Rancidity of oils-peroxide value.
8. Extraction and Estimation of polyphenols.
9. Extraction and Estimation of flavonoids.
10. Determination of titratable acidity and pH of fruit juice

REFERENCES / MANUALS/SOFTWARE:

1. Sadasivam, S., and Manickam, A., "Biochemical Methods ", Third Edition, New Age International, Delhi, 1996.
2. Ranganna. S, Handbook of Analysis and Quality Control for Fruit and Vegetable Products, 2nd Edition, Tata McGraw-Hill.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Determine the physico-chemical properties of food samples

CO2: Extract and estimate the biomolecules in food samples.

CO3: Extract and estimate the bioactive compounds in food samples.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2		3	1				3			1
CO2	2	2		3	2				3			1
CO3	2	2	1	3	2	1			3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT408 FOOD MICROBIOLOGY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS/ EXERCISES

1. Examination of Microorganisms of normal and spoiled fruits and vegetables
2. Examination of Microorganisms spoiled cereal products
3. Examination of Microorganisms spoiled bakery and confectionery products
4. Microbial examination of packed / canned foods
5. Microbial examination of meat / fish.
6. Microbial examination of potable water
7. Microbial examination of fermented foods
8. Microbial examination of dairy products
9. Microbiological analysis of utensils and processing plants
10. Food preservation by fermentation
11. Food preservation by low and high temperature
12. Food preservation with chemical

REFERENCES / MANUALS/SOFTWARE:

Ahmed Elmeleigy Yousef, Carolyn Carlstrom., "Food Microbiology: A Laboratory Manual", Wiley-Interscience Publications, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Examine and assess the microorganisms present in fresh and spoiled food samples.

CO2: Select and apply the appropriate preservation method

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2		3					3			1
CO2	2	1	1	3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT501 FOOD PROCESS ENGINEERING- I

3 1 0 4

MODULE - I **15**

Post Harvest Processing: Post harvest losses in field crops - Cleaning, Wet and dry cleaning, Screen Cleaners, Air Screen Cleaners - Peeling, Flash steam, Knife, Abrasion, Caustic and flame peeling - Grading and Sorting - Principles, types, equipments - Disk separator, Indented Cylinder Separator, Spiral separator, Specific gravity separator, Destoner, Inclined draper, Velvet roll separator, Magnetic separator, and Color separator.

Moisture content – free moisture, bound and unbound moisture, Equilibrium moisture content, EMC determination methods, EMC Models, Importance, hysteresis effect. Water activity and its importance.

MODULE - II **15**

Drying: Theory and mechanism of drying, drying characteristics of materials, Psychometric chart, uses, constant rate and falling rate drying, thin layer and deep bed drying, methods of drying agricultural materials - batch and continuous drying. Types of dryers – Tunnel, Belt Dryers, Drum Dryers, Spray Dryers, Fluidized Bed Dryers, Spouted bed dryer, Pneumatic Dryers, Rotary Dryers, Vacuum Drying, Freeze Drying, Heat Pump drying, Micro wave drying, Di-electric drying, Impingement drying, Flash drying.

MODULE - III **15**

Preservation by Heating: Methods of applying heat to food – Blanching, Pasteurization, Sterilization - Theory, Equipments, Thermal death time relationships (D, Z and F values), UHT Sterlization Aseptic processing and packaging – Principles of aseptic technology.

Preservation by Cooling: Chilling – Theory, chilling equipments, Storage by chilling, Freezing – Theory, freezing time calculations, methods of freezing, freezing equipments, Freeze Drying and Freeze concentration – Theory, Equipments.

Lecture: 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Fellows, P.J. “Food processing Technology: Principles and practice”, Second edition, Woodhead publishing limited. Cambridge, 2005.
2. Sahay, K.M. and Singh K.K.. “Unit Operations of Agricultural Processing”, Vikas Publishing House Pvt. Ltd., New Delhi, 2003.
3. Earle, R.L. “Unit Operations in Food Processing”, Pergamon Press, New York, 1989.

REFERENCE BOOKS

1. Dennis, R.H. “Food Process Engineering”, The AVI Publishing Co., Connecticut. 1971.
2. Mujumdar, Arun S., “Drying Technology in Agriculture and Food Sciences”, Science Publishers Inc. Chicago, 2000.
3. Chakraverty, Ed., Mujumdar, Raghavan and Ramaswamy, “Handbook of Post-Harvest Technology”, Marcel Dekker, New York, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Choose the pre-processing operations and estimate the moisture content of food materials.

CO2: Illustrate the concept of drying and classify dryers.

CO3: Appraise the techniques of preservation by heating and cooling.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2			2	1						
CO2	3	2	2	1	2	1						1
CO3	3	2	2	1	2	1						1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT502 REFRIGERATION AND COLD CHAIN MANAGEMENT

3 1 0 4

MODULE – I **15**

Introduction: Introduction to refrigeration, unit of refrigeration capacity Thermodynamics: First law of thermodynamics and Second law of thermodynamics. Thermodynamic state of a pure substance. Production of low temperatures; principles and process. Thermodynamic properties of refrigerants; Enthalpy and Entropy calculations. Refrigeration machine; Second law of thermodynamics interpretation. Energy ratios, COP, Power consumption of a refrigerating machine.

MODULE - II **15**

Refrigeration Cycles: Carnot cycle and reversed Carnot cycle. Vapour and gas as refrigerant in reversed Carnot cycle. Limitations of reversed Carnot systems. Actual refrigeration systems. Vapour compression cycle, calculations. P-H diagram-problems. Standard rating cycle and effect of operating conditions Refrigerants and Components of a Refrigeration system: Evaporator-Latent heat and pressure drop in evaporator, liquid cooling evaporator; Condenser- water cooled condenser, Shell and coil condenser, shell and tube condenser, Evaporative condenser, Air cooled condenser; Compressor- reciprocative type compressor, valve design and compressor efficiency; Expansion valves.- thermostatic expansion valve.

MODULE - III **15**

Applications of Refrigeration and Air Conditioning: Freezing of foods, types of freezers. Refrigeration load in freezers. Calculation of freezing time. Freezing in air. Modified Planck's law for calculation of freezing time. Cold storage design-problem. Transport Refrigeration - Refrigerated trucks. Examples of food processing in refrigeration and storage. Candy manufacture, Beverage processing. Bakery products, meat products, poultry products, fishery products, fruit and vegetables and dairy.

TOTAL : 45

TEXT BOOKS

1. Rajput, R K, Refrigeration And Air-conditioning. S. K. Kataria & Sons (publishers), Delhi-110002
2. Arora, C.P. Refrigeration and Air Conditioning. Second edition. Tata McGraw-Hill Publishing Company Ltd. Delhi. 2000.

REFERENCE BOOKS

1. Ananthakrishnan, C. P. and Sinha, M.N. "Technology and Engineering of Dairy Plant Operations", Laxmi Publications, New Delhi, 1997.
2. Farrall. A.W. "Engineering for Dairy and Food Products", John Wiley & Sons, New York, 1995.
3. Robinson .R.K. "Modern Dairy Technology", Volume. I: Advances in Milk Processing, Elsevier Applied Science Publishers, London, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Interpret the basics of refrigeration with thermodynamic principles.

CO2: Perceive the concept of refrigeration cycles and components of refrigeration system

CO3: Apply the refrigeration and cold chain management for processing and preservation of foods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2				1						
CO2	3	2			1							1
CO3	3	2	2			2	2					2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT503 DAIRY ENGINEERING

3 0 0 3

MODULE – I **15**

Introduction: Operation Flood Programme in India. Definition of milk, types of milk Sources and composition, factors affecting composition. Basis for pricing of milk. Nutritive value of milk.

Physico-chemical properties of milk: Colour, flavour, specific gravity, & density, boiling and freezing point, refractive index, acidity and pH, viscosity, surface tension, thermal conductivity, Platform tests like-smell, appearance, temperature, sediment, acidity, lactometer reading, fat, SNF, Resazurin tests, die reduction test, MBRT test, Mastitis test.

MODULE - II **15**

Fluid Milk Processing: Fluid Milk Processing straining, Filtration and clarification. Bactofuge, Cream separation – separator, Homogenization Classification, single stage and two stage homogenizer and its effects, homogenizer valve and its efficiency; standardization- Pearson' square method.

Pasteurization; LTLT, HTST: Plate Heat Exchanger (flow division valve, Heating system, cooling system, flow controller, regenerator,), Sterilization; Different type of sterilizers, UHT sterilization.

MODULE - III **15**

Packaging and Cleaning of Fluid Milk: Principles and working of different types of bottle filters and capping machine, pouch filling machine, aseptic processing, packaging and filling machines for bulk handling.

Cleaning, cleaning agents, Description, working principle and maintenance of can washers, bottle washers. Factors affecting washing operations. CIP and COP cleaning and designing of system.

TOTAL : 45

TEXT BOOKS

1. Sukumar De. R. "Outlines of Dairy Technology", Royal, Oxford University, Press, Delhi. 1983.
2. Tufail Ahmed. "Dairy Plant Engineering and Management", CBS Publishers and Distributors, New Delhi. 2001.

REFERENCE BOOKS

1. Ananthakrishnan, C. P. and Sinha, M.N. "Technology and Engineering of Dairy Plant Operations", Laxmi Publications, New Delhi, 1997.
2. Farrall. A.W. "Engineering for Dairy and Food Products", John Wiley & Sons, New York, 1995.
3. Robinson .R.K. "Modern Dairy Technology", Volume. I: Advances in Milk Processing, Elsevier Applied Science Publishers, London, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline and infer physico-chemical properties of milk.

CO2: Elaborate the technical aspects of fluid milk processing

CO3: Perceive fluid milk packaging and cleaning operations in dairy industry

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1	1									
CO2	3	2	2	1	2	1						2
CO3	3	1	1		2	2						1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT504 MILLING TECHNOLOGY FOR FOOD MATERIALS

3 0 0 3

MODULE - I **15**

Grain Properties: Importance of grains and cereals - definitions, Grain structure, Physico-chemical properties of grains and its nutritional value. Storage of cereal grains in relation to maintaining grain quality – types of storage structures.

Milling of Rice: Rice milling flow sheet. Explanation of steps in milling operations - Cleaning, Parboiling- Physio – chemical changes during Parboiling and effects of qualities of rice. Methods of Parboiling, Milling, Shellers, Paddy Separator, Whitener, Polisher, Grader, and modern rice mill. Byproducts from rice milling and waste utilization.

MODULE - II **15**

Milling Process of Wheat: Wheat milling flow sheet. Explanation of steps in milling, Cleaning, Principles of Parboiling of wheat- Methods of Parboiling, Sifters, De-stoners, Roller milling - Break rolls, and reduction rolls, Sifting and purifying, plan sifters. Bran separation. Efficiency of milling process. By products from wheat milling and waste utilization.

Milling of Corn: Corn – types. Dry and wet milling of corn – flow sheet and explanation, By products from corn milling, corn starch, corn syrup, corn flakes. Waste utilization.

MODULE - III **15**

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

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

TOTAL: 45

TEXT BOOKS

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

REFERENCE BOOKS

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

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Perceive grain properties and rice milling operations.

CO2: Outline the process involved in wheat and corn milling.

CO3: Recommend the equipments and technologies for milling of pulses and oilseeds.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1	1		2		1					1
CO2	3	1	2		2		2					1
CO3	3	1	2		3		2					1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT505 BAKING AND CONFECTIONERY TECHNOLOGY

3 0 0 3

MODULE – I **15**

Introduction to Baking - Classification of bakery products. Bakery ingredients and their functions- Essential ingredients: Flour, yeast and sour dough, water, salt- Other ingredients: Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants. **Equipments**: Introduction to utensils and equipments used in bakery industry with their purpose. Bulk handling of ingredients- Dough mixing and mixers, Dividing, rounding, sheeting, and laminating- Fermentation enclosures and brew equipment - Ovens and Slicers. Rheology of dough- Farinograph, Amylograph, Alveograph, and Extensiograph.

MODULE - II **15**

Bread Making Process: The Chemistry of Dough Development. Bread making methods- Straight dough/bulk fermentation - Sponge and dough- Activated dough development- Chorley wood bread process- Dough retarding and freezing-emergency No time process. Advantages and disadvantages of various methods of bread-making. Characteristics of good bread**:** Internal characters; external characters. Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention.**Bakery Products:** Production of cakes and cookies/biscuits. Types of biscuit dough's – Developed dough, short dough's, semi-sweet, enzyme modified dough's and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking.

MODULE - III **15**

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

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

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

REFERENCE BOOKS

1. Edwards W.P. " Science of bakery products", Published by The Royal Society of Chemistry, UK,2007
2. Samuel A. Matz., "Equipment for Bakers", Pan Tech International Publication. 1988.
3. Sugar Confectionery manufacture-(Ed) E.B.Jackson, 2nd edition, Blackie Academic and professional, Glasgow (1995).

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: List and choose the ingredients and equipments used in baking.

CO2: Demonstrate the manufacturing of bread and other bakery products.

CO3: Formulate ingredients for development of confectionery products.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2			1							1
CO2	3	3	2									1
CO3	3	3	2									1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT506 FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

3 0 0 3

MODULE - I **15**

Properties of Fruits and Vegetables: Current status of production and processing of fruits and vegetables. Classification of fruits and vegetables. Structural features, composition & nutritional aspects. Physiological Development: Growth, maturation, maturity index, ripening, senescence.

Post Harvest Handling: Harvesting, methods and devices. Post harvest losses. Deterioration factors, physical changes, chemical changes, enzymatic changes, Methods of reducing deterioration. Composition and related quality factors for processing. Pre-preparatory operations and related equipments- washing, cleaning, grading, peeling and blanching methods. Pretreatments.

MODULE - II **15**

Storage & Preservation by low temperature: Principles of storages of fruit and vegetable: storage under ambient conditions, low temperature storage – cold storage, evaporative cooling and freezing - types of freezing systems, its effect on quality, controlled and modified atmosphere storage- concepts and methods.

Preservation By Sugar and Chemicals: Processing of Juice, pulp, concentrate syrup, squash, cordial and nectar. Equipments for juice and pulp extraction. Clarification. Unfermented beverages. Candies & preserves. Intermediate moisture foods. Preparation of jam, jellies and marmalades. Gel formation. Types of pectin. Defects in jam and jelly. Concentrated juice.

MODULE - III **15**

Preservation By Dehydration and Canning: Dryers for the production of Fruit powders. Effect of drying on fruits and vegetables. Problems related to storage of dehydrated products. Canning. Types of cans and materials, syruping and brining. Flowchart of canning operations – equipments. Factors affecting heat penetration in cans. Precautions in canning operations. Spoilage of can.

Processing of Fruits and Vegetables: Sauerkraut, pickle and vinegar production. Fermented fruit beverages. Processing of tomato, mango, tapioca, potato. Irradiation. Waxing- types of waxes, method of wax application. Minimal processing of fruits and vegetables. Utilization of waste from fruit and vegetable processing.

TOTAL: 45

TEXT BOOKS

1. Ranganna S., "Handbook of Analysis and Quality Control for Fruit and Vegetable", Tata McGraw-Hill, 1986.
2. Lal, G., Siddappa, G. and Tondon G.L. "Preservation of Fruits and Vegetables", Indian Council of Agricultural Research, New Delhi, 1986

REFERENCE BOOKS

1. Desrosier, N.W. "The Technology of Food Preservation", CBS Publisher & Distributions, New Delhi, 1987.
2. Chakraverty, A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. "Handbook of Post-harvest Technology", Marcel Dekker Press, USA, 2001.
3. Srivastava, R.P. and Kumar, S. "Fruit and Vegetable Preservation: Principles and Practices", Second Edition, International Book Distribution Co. Lucknow, 1998.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Inspect physico-chemical properties and post-harvest handling of fruits and vegetables

CO2: Choose the suitable storage and preservation techniques for fruits and vegetables.

CO3: Adapt appropriate processing techniques based on the produce.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3		2									1
CO2	3	3	3		2	2						2
CO3	3	3	3		2	2	2					2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT507 DAIRY ENGINEERING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS/EXERCISES

1. Studies on Milk sampling, judging and grading of milk
2. Experiment on clot on Boiling test and Alcohol index of milk
4. Experiment on Sedimentation and specific gravity test
3. Determination of Fat, SNF and total solids of milk
4. Determination of Refractive index of milk
5. Methylene blue reduction (MBR) test for milk
6. Resazurian test of milk.
7. Experiment on pasteurization and regeneration efficiency of milk.
8. Determine the efficiency of homogenizer
9. Determine the efficiency of spray drier using fluid milk.
10. Determine separating efficiency of cream separator.
11. Determination of churning efficiency of butter churner..
12. Preparation of tonned and double tonned milk

REFERENCES / MANUALS/SOFTWARE:

Sukumar De. R. "Outlines of Dairy Technology", Royal, Oxford University, Press, Delhi. 1983.
Tufail Ahmed. "Dairy Plant Engineering and Management", CBS Publishers and Distributors, New Delhi. 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Analyse the physico-chemical properties of milk

CO2: Judge the quality of milk.

CO3: Demonstrate/evaluate the performance of dairy equipments

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2		3					3			1
CO2	2	2		3					3			1
CO3	2	2		3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT508 BAKING AND CONFECTIONERY LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Study of ingredients (major and minor): characteristics of flour, yeast, shortening, sugar, egg and salts.
2. Experiment on leavening action of baking powder, sodium- bicarbonate and ammonium-bi-carbonate.
3. Determination sedimentation value of flour
4. Estimation of gluten content (atta, and maida)
5. Estimation of water absorption power (atta, and maida)
6. Determination dough rising capacity of yeast
7. Studies of dough characteristics farinographic and extensographic
8. Preparation of biscuits-different types.
9. Preparation of bread-different types.
10. Preparation of toffees.
11. Preparation of sugar boiled confectionary.
12. Preparation of candy.

REFERENCES / MANUALS/SOFTWARE:

Sugar Confectionery manufacture-(Ed) E.B.Jackson, 2nd edition. Blackie Academic and professional, Glasgow(1995).

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Analyze the quality parameters of ingredients

CO2: Develop bakery and confectionery products.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2		3					3			1
CO2	2	2	3	3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT509 FRUIT AND VEGETABLE PROCESSING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Determination of maturity index of fruits.
2. Experiments on different peeling methods.
3. Experiments on efficiency of juice extractor and pulper.
4. Experiments on controlling browning in fruits and vegetables.
5. Experiments on drying using tray dryer.
6. Experiments on osmotic dehydration of fruits.
7. Preparation of Jam.
8. Preparation of squash.
9. Preparation of tomato sauce.
10. Preparation of fruit bar.
11. Experiments on minimal processing of vegetables.
12. Experiments on drying using freeze dryer.

REFERENCES / MANUALS/SOFTWARE:

Girdhari Lal, Siddappa G.S. and Tandon G. L., "Preservation of Fruits and Vegetables", Indian Council of Agricultural Research, New Delhi. 1986.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Examine fruits/vegetables for processing

CO2: Formulate the fruit based products

CO3: Evaluate the performance of dryer, juice extractor and pulper

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2			3					3			1
CO2	2	1	3	3					3			1
CO3	2	1	2	3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11GE601 ECONOMICS AND MANAGEMENT FOR ENGINEERS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Economics – Basics Concepts and Principles – Demand and Supply – Law of demand – Determinants of demand, Law of supply – market Equilibrium – National Income – Circular Flow of Economic activities and Income –National Income and its measurement techniques – Inflation – Causes of Inflation – Controlling Inflation –Business Cycle .

MODULE – II **15**

Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling- Managerial Skills - Levels of Management - Roles of manager.

Marketing – Core Concepts of Marketing, Four P's of Marketing, New product development, Product Life Cycle, Pricing Strategies and Decisions. Operations Management – Resources – Site selection, Plant Layout, Steps in Production Planning and Control – EOQ Determination

MODULE – III **15**

Accounting Principles – Financial Statements and its uses – Time value of Money – Depreciation methods — Break Even Analysis – Capital budgeting techniques – Introduction to FDI, FII, Mergers & Acquisition.

TOTAL : 45

TEXT BOOKS

1. Geetika, Plyali Ghosh, Purba Roy Choudhury, "Managerial Economics", 1st Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Jeff Madura, "Fundamentals of Business", Cengage Learning Inc, India, 2007.

REFERENCE BOOKS

1. Stanley L. Brue and Campbell R Mcconnell, "Essentials of Economics", Tata McGraw-Hill, New Delhi, 2007.
2. S.P.Jain, K.L.Narang, Simi Agrawal, "Accounting for Management", First Edition, Tata McGraw-Hill, New Delhi, 2009

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: estimate market equilibrium and interpret national income calculation and inflation issues

CO2: categorize the forms of business and analyse the functions of management

CO3: appraise marketing and operations management decisions

CO4: interpret financial and accounting statements

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1	1	2			3		2	2	2	3	2
CO2		1	2			2	2	2	2	2	3	2
CO3	1	2	1			2		2	2	2	3	2
CO4	2	2				2		2	2	2	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11MA601 PROBABILITY AND STATISTICS

(Common to EEE, EIE and Food Technology branches)

3 1 0 4

MODULE – I **15**

Probability and Random Variables: Axioms of probability- Conditional probability – Total probability – Baye's theorem – Random variable – Probability mass function – Probability density function – Moments- Moment generating functions.

MODULE – II **15**

Discrete Distributions: Binomial distribution – Poisson distribution - Geometric distribution.

Continuous Distributions: Uniform distribution – Exponential distribution - Normal distribution and its properties.

MODULE – III **15**

Testing of Hypothesis: Small and large samples – Tests concerning simple means- Comparing means – Proportions – Test for independence - Test for equality of variances- goodness of fit.

Design of Experiments: Analysis of variance- One way classification – Completely Randomized Design - Two way classification – Randomized Block Design – Latin Square Design.

Lecture 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi,Ninth Edition 2011.
2. Miller and Freund's, "Probability and Statistics for Engineers", Eighth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

REFERENCE BOOKS

1. Kandasamy P., Thilagavathi K. and Gunavathi K., "Probability Statistics and Queuing Theory", S. Chand & Co., New Delhi,Fourth Edition 2010.
2. Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw-Hill, New Delhi,Third Edition 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Discuss the concepts of basic probability and random variables.

CO2: Decide the appropriate distribution to be applied to solve industrial problems.

CO3: Predict the various tests for handling the large and small samples.

CO4: Test the degree to which two or more groups vary in experimental observations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3		1	2							1
CO2	3	3		1	2							1
CO3	3	3			2							1
CO4	3	3		1	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT601 PROCESS INSTRUMENTATION AND CONTROL

3 1 0 4

MODULE – I **15**

Laplace Transform and First Order System: Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions. First order systems in series

Second Order System: Linearization and its application in process control, Second order systems - Interacting system and non interacting system, manometer, damped oscillator, dynamic response of second order system.

MODULE - II **15**

Design of Feedback Control System

Controllers and Dynamic Response: Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, controllers - Proportional, Proportional Integral, Proportional Derivative and Proportional Integral Derivative (PID). Dynamic behavior of feedback controlled processes. Effect of proportional, Integral, Derivative and composite control actions on the response of controlled processes.

Frequency Response: Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, bode stability criterion, Routh stability criterion.

MODULE - III **15**

Process Instruments

Temperature Measurement: Principles of measurements and classification of process control instruments, measurements of temperature – Expansion Thermometer; filled system thermometers; electrical temperature instruments; pyrometers.

Pressure Measurement: Pressure measurements - elastic pressure transducers; pressure measurement by vacuum; electrical pressure transducers, Control valves.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Stephanopoulos. S.G "Chemical Process Control: An introduction to Theory and Practice", Prentice Hall of India, New Delhi, 1997.
2. Singh, S.K. "Industrial Instrumentation and Control", Second Edition, Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. Vyas, R.P., "Process Control and Instrumentation" Central Techno Publications, Nagpur, 2001.
2. Coughanowr, Donald R., "Process Systems Analysis and Control" , McGraw Hill, New York, 1991
3. Eckman D.P., "Industrial Instrumentation", Wiley Eastern Ltd, New Delhi, 1991.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the Laplace transformation for first and second order control systems.

CO2: Infer the concepts of feedback controller and examine its stability.

CO3: Interpret temperature and pressure measuring instruments.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2		1	2							1
CO2	3	2	1	1	3							1
CO3	3	2		1	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT602 FOOD PROCESS ENGINEERING - II

3 1 0 4

MODULE – I **15**

Size Reduction and Mechanical Separation

Size Reduction - Fibrous foods, dry foods and liquid foods – Energy Used in Grinding- New Surface Formed by Grinding - Grinding and cutting-various grinding equipments. (Crushers, Hammer mills, Fixed-head mills, Plate mills, Roller mills, Miscellaneous milling equipment, and Cutters).

Mechanical Separation: Sedimentation - Gravitational sedimentation – Floatation - sedimentation of particles in liquid & gas, settling under combined forces - Centrifugal separation - Sieving. Membrane separation - Filtration - Equipments and Application.

MODULE - II **15**

Mixing and Crystallization:

Mixing: Characteristics of mixtures, Measurement of mixing - sample size, sample composition. Particle mixing - random mixture, thorough mixture, mixing index. Mixing of different quantities, Rates of Mixing. Energy Input in Mixing, Liquid mixing - Propeller Mixers, Power number, Mixing equipments - Liquid Mixers, Powder and Particle Mixers ,Dough and Paste Mixers.

Crystallization: Crystallization Equilibrium – Nucleation – Meta stable region – Seed Crystals – Heat of Crystallization - Rate of crystal growth – Stage equilibrium crystallization – Equipments - types – operation – application. Cryogenic grinding and its application.

MODULE - III **15**

Extrusion and Material Handling & Conveying Systems:

Extrusion: Extrusion - -single and multiple screw extruders- ancillary Equipments-Newtonian and non-Newtonian models for extruders. Dies, Comparison of Single screw and Multiple screw extruders, Applications of extrusion – Effects on Foods.

Material Handling and Conveying Systems: Material handling – Importance and Selection of handling and conveying systems, types of handling and conveying system for food products and their design - Belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Earle R. L., “Unit Operations in Food Processing", Pergamon Press Oxford, UK, 1985.
2. Fellows P., “Food Processing Technology. Principles and practice”, Ellis Harwood International publishers, Chichester, England, 1988.

REFERENCE BOOKS

1. Sahay, K.M. and Singh, K.K. “Unit operations in Agricultural Processing”, Vikas Publishing House Pvt. Ltd., New Delhi, 1994.
2. McCabe, Warren Lee., Smith, Julian Cleveland, and Harriott, Peter., “Unit Operations of Chemical Engineering”, McGraw-Hill, New York, 2005.
3. Leninger, H.A and Beverloo,W. A., “Food Process Engineering”, The AVI Publishing Co., Connecticut, 1975.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the concept of size reduction and mechanical separation in food processing.

CO2: Elaborate the mixing and crystallization process.

CO3: Outline the extrusion process and material handling systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2			2							1
CO2	3	2	2		2							1
CO3	3	2	2		2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT603 FOOD QUALITY ASSURANCE AND CONTROL

3 1 0 4

MODULE – I **15**

Food Quality, Standards & Testing: Quality of Foods and Quality Standards like BIS; Agmark and other optional standards; the difference between mandatory and optional standards; enforcement of optional standards; Food Safety Systems: Quality systems standards including ISO; Auditing; Good Manufacturing Practice and HACCP

Standards of Weights & Measures and some provisions under these regarding food products such as requirements of labelling and giving information therein, size of packages etc. Important Issues of GM Foods, Fortification, Nutrition Information on Label, Pesticide Residues, Organic Foods, Safety of Additives, Processes etc. affecting consumers and industry.

MODULE - II **18**

Quality Assurance in the Food industry: Objectives, importance and functions of quality control; Concept of quality assurance and quality control in relation to food industry; role of international organisations such as ISO; IDF; CAC; AOAC; WTO, Food regulations, grades and standards, Concept of Codex Alimentarius/HACCP/USFDA/ISO 9000 series etc.. and national organisations like BIS; CCFS; and Agmark; (MMPO) and APEDA (Agricultural and Processed Foods Export Development Authority, guidelines for setting up quality control laboratory;

Food adulteration and food safety; Food laws and standards, function and roles of USFDA, USDA and EPA; Food Safety and Standards Act India 2006; Prevention of Food Adulteration Act, India, 1954; Responsibilities of the Food service operator, consumer protection, food audit; IPR and patents

MODULE - III **12**

Sampling and Statistical Quality Control: Quality and specification of raw materials and finished products; statistical quality control including use of control charts and sampling procedures; Sensory evaluation-introduction, panel screening, selection methods; selection and training of sensory panel;

Instrumental analysis in quality control; Hedonic rating of food; Identification and ranking of food product attributes, interaction and thresholds; Sensory and instrumental methods for measuring food attributes.

TOTAL : 45

TEXT BOOKS

1 Mehta, Rajesh and George, J. "Food Safety Regulations Concerns and Trade" : The Developing Country Perspective", Macmillan, New Delhi, 2005

2 Schmidt, Ronald H. and Rodrick, G.E. "Food Safety Handbook", Wiley Interscience, UK, 2005.

REFERENCE BOOKS

1 Paster, Tara "The HACCP: Food Safety Training Manual", John Wiley, Oxford, 2006.

2 Mortimone, Sara and Wallace, Carot, "HACCP" (Food Industry Briefing Series), Blackwell Science, Oxford, UK, 2007

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Develop knowledge on Food quality standards.

CO2: Apply the principles of quality assurance and management systems in food industries.

CO3: Relate the sampling techniques and statistical tools for food analysis.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	1	1			2		2				1
CO2	2	2	2			3		2				2
CO3	2	2		1	2	3		1				1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT604 MEAT, FISH AND POULTRY PROCESS TECHNOLOGY

3 0 0 3

MODULE – I **15**

Meat Processing: Recent trends in meat processing. Types of Meat and its sources, composition, structure, of meat and meat products. Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Color, flavors, microbiology and spoilage factors of meat and meat products.

Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features. Preservation of meat- aging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages.

MODULE - II **15**

Fish Processing Types of fish, composition, structure, and spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, Chilling of fish, Freezing and Individual quick freezing.

Canning and smoking operations, Salting and drying of fish, pickling. Radiation processing of fish and fish products. Seafood quality Assurance, Advances in fishery by products technology.

MODULE - III **15**

Poultry and Egg Processing: Introduction, Types and characteristics of poultry products, composition, nutritive value, calculation of nutritive value of poultry products. Unit operation involved in poultry processing.

Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing.

TOTAL : 45

TEXT BOOKS

1. Govindan. T.K, "Fish Processing Technology", Oxford and IBH Publishers, New Delhi, 1985.
2. Lawrie, R.A. "Meat Science", Second Edition. Pergamon Press, Oxford, UK. 1975.
3. Stadelmen, W.J. and Cotterill, O.J., "Egg Science and Technology", Second Edition, AVI, Westport, 1977.

REFERENCE BOOKS

1. Joseph Kerry, John Kerry and David Ledwood. "Meat Processing", Woodhead Publishing Limited, England (CRC Press), 2002.
2. Mead, G. "Poultry Meat Processing and Quality", Woodhead Publishing, England, 2004.
3. Wheaton, F.W. and Lawson, T.B., "Processing of Aquatic Food Products", John Wiley & Sons Publishers, New York. 1985.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Elaborate the handling and processing of meat.

CO2: Summarize the fish processing and preservation techniques.

CO3: Apply unit operations and preservation techniques in poultry and egg processing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3		2		2	1						1
CO2	3		3		2	1						1
CO3	3		2		2	1						1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT605 FOOD PROCESS ENGINEERING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Determination of Size, roundness, sphericity and 1000 grain weight of food grains
2. Determination of bulk density, true density and porosity
3. Determination of angle of repose for a given sample
4. Determination of co efficient of friction for given sample
5. Experiment on drying characteristics of food material
6. Determination fineness modulus using sieve shaker
7. Experiment on Cyclone separation to determine the separation efficiency
8. Experiment on Screw conveyor to determine the conveying efficiency and power requirement
9. Experiment on size reduction of food material using ball mill
10. Experiment on hammer mill to analyze the particle distribution
11. Experiment on texture analyzer
12. Experiment on Paddy dehusker

REFERENCES / MANUALS/SOFTWARE:

Sharma Shri K., Mulvaney Steven J. and Rizvi Syed S. H., "Food Process Engineering: Theory and Laboratory Experiments", Wiley Inter-science, New York, 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Estimate engineering properties of agricultural produce.

CO2: Evaluate the performance of agro processing equipments.

CO3: Evaluate the effectiveness of size reduction equipments.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1	1	3					3			1
CO2	3	1	1	3					3			1
CO3	3	1	1	3					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT606 FOOD ANALYSIS AND QUALITY CONTROL LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Importance of sampling and techniques of sampling.
2. Determination of pectin substances using different methods.
3. Test to detect the adulteration of food materials
4. Estimation of consistency, viscosity and texture for given food samples.
5. Estimation of taste and flavor for given food samples.
6. Estimation of sugars using HPLC
7. Detection and estimation of additives in food materials
8. Detection of adulteration in foods.
9. Estimation of toxins and pesticide in foods.
10. HACCP- Product Description and Process Flow Diagram for food materials.
12. Familiarization of to AGMARK and BIS laboratories standards

REFERENCES / MANUALS/SOFTWARE:

Sadasivam, S., and Manickam, A., "Biochemical Methods", Third Edition, New Age International, Delhi, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Analyze and estimate the additives in food materials.

CO2: Recommend the safety and quality control standards for food process/products.

CO3: Identify the presence of adulterants in food materials.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	3		3	2	2			3			1
CO2	2	1	1	3	1	2			3			1
CO3	2	2		3	1	2			3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11GE701 TOTAL QUALITY MANAGEMENT

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Quality Systems: Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs, Basic concepts of Total Quality Management, Historical Review. Need for ISO 9000 and Other Quality Systems, ISO 9000:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, Introduction to TS 16949, QS 9000, ISO 14000, ISO 18000, ISO 20000, ISO 22000.

MODULE – II **15**

TQM Principles: Principles of TQM, Leadership – Concepts, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation. Customer satisfaction – Customer Perception of Quality, Customer Complaints, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts.

MODULE – III **15**

TQM Tools: The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools, Poka Yoke. Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

TOTAL :45

TEXT BOOKS

1. Besterfield, Dale H. et al., "Total Quality Management", Third Edition, Pearson Education, 2008
2. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Feigenbaum. A.V, "Total Quality Management", Tata McGraw Hill, New Delhi, 1999.
2. Suganthi, L and Samuel A Anand., "Total Quality Management", PHI Learning, New Delhi.
3. Evans James R. and Lindsay William M., "The Management and Control of Quality", Seventh Edition, South-Western (Thomson Learning), 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the evolution and basic concepts of TQM

CO2: interpret various ISO standards and their implementation procedures

CO3: apply the principles of TQM and its elements in real time scenario

CO4: adapt quality tools and techniques to implement TQM at the work place

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1						2	2	3	2	2	2	2
CO2						3	3	3	3	2	2	2
CO3					2	3	2	3	3	3	2	2
CO4	3	2	2	2	2	1		2	2	2	3	3

3 – Substantial, 2 – Moderate, 1 – Slight

11FT701 FOOD PACKAGING TECHNOLOGY

3 0 0 3

MODULE – I **15**

Metal Cans and Glass Containers

Basics of Packaging: Basic concepts of packaging. Definitions and basic functions of a food package. Current status and trends in food packaging in India and abroad. Food package design and development. Packaged product quality and shelf life. **Metal Cans:** Metal cans – requirements and design – raw materials for can making – steel, aluminium – can making processes three piece welded cans, DWI, DRD cans – end making processes – coating. Film laminates and inks, metal packages – corrosion and sulphur staining. **Glass Containers**: Glass– definition, composition – white flint, pale green, dark green, amber, blue. Glass container manufacture – melting, forming, surface treatments – closure selection – normal seal, vacuum seal, pressure seal – Glass bottle design and specification- thermal processing – plastic sleeving – strength. Application of metal and glass containers in food industries.

MODULE - II **15**

Plastics and Paper Boards

Plastics: Types of plastics used in packaging – PE, PP, PET, PEN, PC, EVA, PA, PVC, PVdC, PS, EVOH, SB, TPX, PVA, Ionomers – coating of plastic films – secondary conversion techniques – film, extrusion and thermal lamination, printing of plastic films – gravure, flexographic and digital printing, printing of rigid plastic containers – dry offset, silk screen and heat transfer printing, rigid plastic containers – food contact and barrier properties – sealability and closure – heat sealing – flat jaw, crimp jaw, impulse, hot wheel, hot air, gas flame, induction and ultrasonic sealing – plastic closures – retort pouch. **Paper And Paperboard Packaging**: Paper and paperboard – fibre sources and fibre separation – properties of paper and paperboard – paper and paperboard manufacture - SBB, SUB, FBB, WLC – functional properties of paper and paperboard – design for paper and paperboard packaging – package types – paper, ouches, sachets, cartons, boxes, tubes, tubs, containers, drums, tapes, cushion, cap liners and diaphragm. Application of plastics and paperboards for food packaging.

MODULE – III **15**

Recent Trends in Food Packaging

Recent Trends: Vacuum and Inert Gas Packaging. Active packaging, modified atmosphere packaging, Biodegradable and edible packaging, Aseptic packaging, Shrink wrapping, Nano packaging, Antimicrobial packaging, self heating and cooling cans. **Regulations, Recycling and Disposal**: Package standards and regulation. Labeling, Bar coding and legislative requirements. Recycling of non-biodegradable packaging materials, Alternate methods for disposal of plastics. Cost calculation for food packaging.

TOTAL : 45

TEXT BOOKS

1. Robertson, Gordon L., "Food Packaging: Principles and Practice", Marcel Dekker Inc, USA 1993
2. Richard Coles, Derek Mcdowell and Mark J. Kirwan., "Food Packaging Technology", Blackwell Publishing Asia Pty Ltd, CRC press, USA, 2003.

REFERENCE BOOKS

1. Frank A. Paine and Heather Y.Paine "A Hand Book of Food Packaging" Leonard Hill Publications (Blackie and sons), Bombay, 1983
2. Heiss, R. "Principles of Food Packaging. An International guide", P. Keppler Verlag KG, Heusenstamn, Germany. 1970.
3. Mathlouthi M. (Editor) "Food Packaging and Preservation" Elsevier Applied Science Publications Essex, UK. 1986
4. Crosby, N.T. "Food Packaging Materials". Applied Science Publishers Ltd. 1981.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the concepts of packaging and technology of metal and glass containers for quality products.

CO2: Classify plastics and paper and elaborate their properties for different packaging applications.

CO3: Adapt recent trends, standards and regulations in food packaging.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3		2	1		1	1					1
CO2	3		2			1	2					1
CO3	3		3			2	3				1	2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT702 FOOD PROCESS PLANT LAYOUT AND SAFETY

3 0 0 3

MODULE– I **15**

Introduction and classification of food plants, Site selection of plant. Plant location factors plant layout advantages types of layout-characteristics of an efficient layout. Techniques of plant layout.

General requirements and considerations for construction, materials and floors. Drains and drain layout. Ventilation, fly control, mold prevention, illumination in food plants.

MODULE– II **15**

Industrial Safety & Safety Performance

Industrial Safety: Process industries; potential hazards; toxic chemicals and physical safety analysis; high pressure; high temperature operation; radioactive materials; safe handling and operation of machineries;

Safety Performance: Safety Appraisal; effective steps to implement safety procedures; periodic inspection and safety procedures; proper selection and replacement of handling equipments; personal protective equipments.

MODULE– III **15**

Accidents, Health Hazards And Legal Aspects

Industrial accidents – accident costs – identification of accident spots; remedial measures; identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis. Fire prevention and fire protection.

Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – labour welfare act – ESI Act – Workmen Compensation Act.

TOTAL : 45

TEXT BOOKS

1. Handley, William, "Industrial Safety Hand Book", Second Edition, McGraw-Hill New York, 1969.
2. Fawatt, H.H. and Wood, W.S. "Safety and Accident Prevention in Chemical Operation", Inter-science, New York, 1965.

REFERENCE BOOKS

1. Heinrich, H.W., Dan Peterson, P.E. and Nester Rood. "Industrial Accident Prevention", McGraw-Hill Book Co., 1980
2. Blake, R.P., "Industrial Safety", Third Edition, Prentice Hall Inc., New Jersey, 1963.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Develop plant layout and allied systems.

CO2: Appraise industrial safety procedures

CO3: Assess the health hazards and accident preventive measures.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2		2			3	2					1
CO2	2			1		3	2	1				1
CO3	1			1		3	3	1				2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT703 PLANTATION AND SPICES PRODUCTS TECHNOLOGY

3 0 0 3

MODULE – I **15**

Processing of Plantation Crops: Importance of plantation crops – cashew –harvesting – uses of cashew – cashew nut processing. Coconut – harvesting – Processing. Coffee – Occurrence – chemical constituents– fermentation of coffee beans – drying – roasting – Process flow sheet for the manufacture of coffee powder.

Tea - types of tea – green, oolong and CTC – Chemistry and technology of CTC tea – Manufacturing process - Grading of tea**.** Cocoa bean **-** Occurrence – Chemistry of the cocoa bean –Processing of cocoa bean – cocoa powder – cocoa liquor.

MODULE - II **15**

Processing of Spices and Tuber Crops: Pepper, cardamom, ginger and turmeric, cumin, coriander, cinnamon, fenugreek, garlic, clove and vanilla – oleoresins and essential oils – method of manufacture – chemistry of the volatiles – enzymatic synthesis of flavour identicals - quality control - present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

Tuber crops - Chemical composition and processing of tuber crops - tapioca, sugar beet, potato and yam – cleaning and grading - starch and sago production.

MODULE - III **15**

Flavour and Sensory Science: Formulation, origins-thermal generation, biogeneration and natural sources. Analysis-instrumental, modelling and sensory techniques and performance of food flavours.

Sensory evaluation, principles. Methods of sensory evaluation-Discrimination tests-descriptive analysis-affective/ hedonic tests. Thresholds, time-intensity methods, similarity testing, color, texture, sensory quality control, qualitative research methods, consumer test methods and questionnaires, shelf life testing, an introduction to multivariate statistical techniques, and strategic sensory research.

TOTAL : 45

TEXT BOOKS

1. Minifie Bernard W., "Chocolate, Cocoa and Confectionery Technology", Third Edition, Aspen Publication, 1999.
2. "Handbook on Spices", National Institute of Industrial Research (NIIR) Board, Asia Pacific Business Press Inc., New Delhi, 2004.

REFERENCE BOOKS

1. Haard, N.F. and Salunkhe, D.K. "Post harvest Biology and Handling of Fruits and Vegetables", AVI, Westport. 1975.
2. Kader, A. A. "Post Harvest Technology of Horticultural Crops", Second Edition, Division of Agriculture and National Resources, California University. 1992.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Elaborate the processing of plantation crops

CO2: Recommend suitable method for processing of spice and tuber crops.

CO3: Apply the instrumental and organoleptic techniques for sensory analysis.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1	2			1						1
CO2	3	2	2		1	1						1
CO3	3	2	3		3							2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT704 FOOD PACKAGING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Studies on types of packaging material.
2. Experiment on Tear resistance of packaging material
3. Estimation of Puncture resistance of packaging material
4. Estimation of bursting strength of different packaging materials
5. Experiment on water vapour and gas transmission rate of flexible packaging materials.
6. Experiment on compression test of packaging material.
7. Exercise on can measurements and sealing studies.
8. Estimation of crush resistance of different packaging materials.
9. Exercise on Modified atmosphere packaging
10. Exercise on Vacuum packaging.
11. Experiment using drop tester for packaging material.
12. Experiment using leakage tester for packaging material.

REFERENCES / MANUALS/SOFTWARE:

Crosby,N.T."FoodPackagingMaterials".Applied SciencePublishersLtd.1981

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify and categorize food packaging materials

CO2: Evaluate and estimate the properties of packaging materials.

CO3: Experiment with vacuum/modified atmospheric packaging to enhance the shelf life of food materials.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	2		3			1		3			1
CO2	3	2	1	3	2				3			1
CO3	2	1	1	3	2				3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT705 FOOD PROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

1. Studies of symbols and materials used of design and drawing
2. Problems on dimensionless constants and pressure drop
3. Design and drawing of pipes and fittings
4. Design and drawing of supports
5. Design and drawing of storage tanks
6. Design and drawing of agitated vessel
7. Design and drawing of double pipe heat exchangers
8. Design and drawing of shell and tube heat exchangers
9. Design and drawing of plate heat exchanger
10. Design and drawing of single effect evaporator
11. Design and drawing of cyclone separators
12. Design and drawing of rotary drier

REFERENCES / MANUALS/SOFTWARE:

M.V. Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India, New Delhi, 2003.
S.D. Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.
Perry, R.H., and Green, D.W., "Chemical Engineers' Handbook", Seventh Edition, McGraw-Hill. New York, 1997..

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify symbols and materials used for food plant design and layout

CO2: Design and draw pipe accessories and vessels.

CO3: Design and draw heat transfer equipments and separators.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1			1						3			
CO2	3	3	3	1					3			1
CO3	3	3	3	1					3			1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT706 INDUSTRIAL TRAINING

0 0 0 1

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Take part in real time practices in food industries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3	3	3	3	3	2	2	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11GE801 PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Introduction to Human Values and Engineering Ethics: Understanding: Morals- Values-Ethics– Honesty – Integrity – Work Ethic – Service Learning – Civic Virtue –caring – Sharing– Courage – Valuing Time – Co-operation – Commitment – Empathy –Self-Confidence – Character – Spirituality- Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –customs and religion- uses of ethical theories.

MODULE - II **15**

Safety, Responsibilities and Rights: Meaning of Engineering experimentation - engineers as responsible experimenters - codes of ethics for engineers - a balanced outlook on law - the challenger case study. Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights – discrimination- Intellectual Property Rights (IPR)

MODULE - III **15**

Global Ethical Issues and Codes : Multinational corporations - Environmental ethics - computer ethics – weapons development-engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers(IETE),India. etc.

TOTAL: 45

TEXT BOOKS

1. Martin Mike and Schinzinger Roland., “Ethics in Engineering”, Tata McGraw-Hill, New Delhi,2003.
2. Govindarajan M, Natarajan S, and Senthil Kumar V. S., “Engineering Ethics”, Prentice HallofIndia, NewDelhi, 2004.

REFERENCE BOOKS

1. Fleddermann, Charles D., “Engineering Ethics”, Pearson Education/Prentice Hall, New Jersey, 2004.
2. Harris, Charles E., Protchard, Michael S. and Rabins,Michael J., “Engineering Ethics: Concepts and Cases”, Wadsworth Thompson Learning, United States, 2000.
3. Seebauer Edmund G and Barry Robert L., “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Examine the various aspects of human values.

CO2: Develop as responsible experimenters particularly with reference to safety.

CO3: Apply appropriate code of ethics to evaluate the probable consequences of actions.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1						3		3		2		3
CO2	1	2	2	2		2	2	3	3	2		3
CO3				1		2	1	3	3			3

3 – Substantial, 2 – Moderate, 1 – Slight

11FT801 INDUSTRIAL WASTE WATER TREATMENT

3 0 0 3

MODULE– I **15**

Physical Methods: Principles of Screening – Mixing, Equalization – Sedimentation - Filtration, back washing – Accelerated gravity separation – Evaporation- Adsorption– Principles, - Membrane separation - Reverse Osmosis, Nanofiltration, ultrafiltration – electrodialysis.

Chemical Methods: Principles of Chemical treatment – Coagulation, flocculation - Precipitation – floatation, – Disinfection and fluoridation. Ion exchange, Electrolytic methods, Solvent extraction – ozonation, advances oxidation/reduction.

MODULE– II **15**

Biological Treatment- Aerobic: Objectives of biological treatment – significance – kinetics of biological growth – Biological treatment process – aerobic suspended growth treatment process-activated sludge process, aerated lagoons, stabilization ponds, oxidation ditch - aerobic attached growth treatment process-trickling filters.

Biological Treatment- Anaerobic: Rotating biological contactors - anaerobic suspended growth treatment process-anaerobic digestion, USAB - anaerobic attached growth treatment process-anaerobic filter process expanded bed.

MODULE– III **15**

Solid Waste Management: Sludge treatment process, amount and characteristics of sludge, sludge thickening, sludge digestion, sludge conditioning, sludge dewatering, composting, – incineration -thermal reduction and disposal of sludge.

Design Aspects: Selection of unit operations and processes - Design of conventional water treatment plant units – Aerators – Flocculation – clarifier – filters – chlorinators and thickeners.

TOTAL : 45

TEXT BOOKS

1. Metcalf and Eddy, "Wastewater engineering, Treatment and Reuse", Tata McGraw-Hill, New Delhi, 2003.
2. Qasim, S.R., Motley, E.M and Zhu, G. "Water works Engineering: Planning, Design and Operation", Prentice Hall, New Delhi, 2002.

REFERENCE BOOKS

1. Punmia, B.C and Ashok Jain, "Wastewater Engineering", Arihant Publications, Jodhpur, 1996.
2. Qasim, S.R, "Wastewater Treatment Plant: Planning, Design and Operation", Technomic Publications, New York, 1994.
3. McCabe Warren L, Smith Julian C and Harriott Peter., "Unit operations of Chemical Engineering", Sixth Edition, McGraw-Hill, New York, 2005.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify the physical and chemical methods for waste water treatment.

CO2: Select suitable methods in biological waste water treatment.

CO3: Plan a wastewater treatment unit and manage solid waste.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	1	1		2		3					1
CO2	3	1	1		2		3					1
CO3	3	1	3		2	2	3					1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT802 PROJECT WORK

0 0 18 9

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Apply the acquired technical knowledge and skills to solve real time problems

CO2: Design and fabricate food processing equipments

CO3: Formulate and develop value added food products

CO4: Apply scientific research tools for design and optimization of food processing operations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3	3	3	3	3	3	2	3	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3
CO3	3	3	2	3	3	3	2	3	3	3	2	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11CH704 MATERIAL TECHNOLOGY FOR PROCESS INDUSTRIES

(Common to Chemical Engineering and Food Technology branches)

3 0 0 3

MODULE – I **15**

Nature of Materials and Processing of Metals and Alloys: Micro and macro structures, properties and definitions: mechanical, thermal, chemical, electrical and magnetic properties. Casting- hot and cold rolling- extrusion- forging- deep drawing- plastic deformation of metal, single crystal and poly crystalline metals- recovery and recrystallization of plastically deformed metals.

Ferrous Metals: Pure iron, cast iron, mild steel, special steels and alloys, high temperature steels, iron carbide phase diagram, heat treatment of plain carbon steels-Manufacture, properties and application in chemical industries.

MODULE - II **15**

Polymeric Materials: Polymerization reactions-Industrial polymerization methods-Crystallinity and stero-isomerism in thermoplastics – thermosetting elastomers- creep and fracture of polymeric materials.

Composite and Ceramic Materials: Fiber-reinforced plastic composite materials- manufacturing methods-asphalt and asphalt mixtures- wood-sandwich structures. Ceramic crystal and silicate structures, Properties-glasses, porcelain, enamels and their application to chemical process industries.

MODULE - III **15**

Corrosion and Protective Coatings: Definitions and scope, basic theories and mechanism of corrosion, types of corrosion, application of corrosion, theories in equipment design and fabrication- anti-corrosion methods. Organic paints and coatings, metal coatings, linings

Material Selection: General criteria for selection of materials of construction for process industries.

Stainless steel, Alloys of Nickel, Copper, Chromium, Tin, Zinc, Magnesium, Aluminium, Lead and their application to different chemical process equipment and industries.

TOTAL : 45

TEXT BOOKS

1. Khanna O. P., "A text book of Material Science and Metallurgy", Second Edition, Dhanpat Rai Publications, New Delhi, 1998.
2. Hajra Choudhury, S K and Hajra Choudhury, A K., "Materials Science and Processes", Media Promotors & Publishers, Bombay, 1995.

REFERENCE BOOKS

1. Carl. A and Keyser.C.E. "Material Science in Engineering", McGraw-Hill, 1968.
2. Clauster Henry R., "Industrial and Engineering Materials", McGraw-Hill, 1975.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Understand how the different methods of processing of metals and alloys like casting, rolling, extrusion, forging etc.,

CO2: Understand engineering plastics, composites and ceramic materials and their application to Chemical process industries.

CO3: Understand different mechanisms of corrosions and its control and enable selection of material for different applications in chemical industries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3			3								
CO2	3			3								2
CO3	3			3								

3 – Substantial, 2 – Moderate, 1 – Slight

11FT011 EMERGING TECHNOLOGIES IN FOOD PROCESSING

3 0 0 3

MODULE – I **15**

Non Thermal Processing of Foods:

High Pressure Processing of Foods: High Pressure Processing – Principle - Description, Packaging requirements, Uses and Effects on food quality. Factors influencing microbial sensitivity to high pressure. High Pressure Regulations. Other applications of high pressure - High pressure freezing, High Pressure thawing, High Pressure non-frozen storage.

Pulsed Electric Field Processing: Principle - Mechanism of action. PEF treatment systems - processing parameters – applications – problems & challenges. **High Intensity Pulsed Light Technology:** Principles of Pulsed Light Technology, Effect of Pulsed Light Technology on food products. Effect on enzymes and food properties, Systems for Pulsed Light Technology.

MODULE - II **15**

Application of Ultrasound and Ohmic Heating in Food Processing:

Ultrasound: Fundamentals of Ultrasound - Physics of ultrasound, Ultrasonic processing equipment - Inactivation of micro-organisms & enzymes - Mixing & Homogenization, foam formation & destruction, precipitation of airborne powders, Filtration & Drying, Extraction - Effects on food quality. **Ohmic Heating:** Fundamentals of Ohmic Heating – Basic Principles, electrical heat generation - electrical conductivity. Generic Configurations - Batch Configuration, Transverse Ohmic heating, Collinear Ohmic heating. Product suitability for thermal treatments.

MODULE - III **15**

Hybrid drying Technologies: Product quality degradation during dehydration – Hybrid drying systems – Heat pump drying, , Radio frequency drying, Microwave drying, Infra red drying. Fluidized bed drying - Flash drying - flash evaporation - principle – working. Super heated steam drying – Pressure regulating drying - Combine microwave-vacuum drying.

TOTAL : 45

TEXT BOOKS

1. Da-Wen Sun. “Emerging Technologies for Food Processing”, Elsevier Academic Press, London, 2005.
2. Zeuthen P. “Food Preservation Techniques”, Wood Head Publishing, England, 2007.

REFERENCE BOOKS

1. Han, Jung H., “Packaging for Non-thermal Processing of Food”, Wiley-Blackwell, Oxford, 2007.
2. Lelieveld H L M., “Food Preservation by pulsed electric fields: From research to application”, Wood Head Publishing Limited, England, 2007.
3. Wilkinson V M and Gould G., “Food Irradiation: A Reference Guide”, Wood Head Publishing Limited, England, 1996.
4. Ohlsson T and Bengtsson N., “Minimal Processing Technologies in The Food Industries”, Wood Head Publishing Limited, England, 2002.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Perceive concepts and effect of high pressure processing, pulsed electric field and pulsed light technology on foods

CO2: Apply the principle of ultrasound and ohmic heating in food processing

CO3: Adapt hybrid drying techniques in food processing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3		2		3	1						2
CO2	3		2		3	1						2
CO3	3		2		3	1						2

11FT012 ADVANCES IN DRYING TECHNOLOGY

3 0 0 3

MODULE – I **15**

Drying and Dehydration Methods: Drying and dehydration - principles - kinetics of drying - mathematical models. Drying curves - quality changes in food during drying. Drying methods – conduction – convection and radiation driers - batch driers - kiln, cabinet tray driers. Continuous driers - tunnel, belt, trough driers and foam mat drying – principle - equipment. Solar dehydration of foods - pretreatment - different models of solar driers – effects on product quality. Osmotic dehydration - fundamentals - Osmotic agents - factors affecting osmotic dehydration. Drying after osmosis – osmo-convective drying, osmo-vaccum drying – effects on quality of the product. Drum drying, principle - types - heat and mass transfer, design consideration.

MODULE - II **15**

Intermediate Moisture Foods

Intermediate Moisture Foods (IMF) - principles - effect of water activity on growth of micro organisms - development of IMF. Pneumatic drying and its applications. Fluidized bed drying - Spouted bed drying - principles - equipment - components of fluidized bed system - design of fluidized bed driers - application to food products. Explosion puffing – principles and applications.

MODULE - III **15**

Recent Trends in Drying Technology

Freeze drying- principle - types - heat and mass transfer, design consideration. Freeze drying with heat input by microwaves - changes in food material - industrial developments. Spray drying - principle of operation - mechanism of atomization - heat and mass transfer in drying chamber. New atomizer designs. Novel dehydration techniques – radio frequency drying – Infra red drying - flash drying - flash evaporation - principle – working. Use of sonic and ultrasonic energy in dehydration - Ecal process of dehydration. Energy requirements in different methods of dehydration. Radio frequency drying.

TOTAL : 45

TEXT BOOKS

1. A.S.Mujumdar. Handbook of Industrial drying – Third edition, CRC press, Taylor and Francis group.UK.2007
2. Spicer Arnold., "Advances in Pre-Concentration and Dehydration of Foods", Applied Science Publisher Ltd., London. 1974.

REFERENCE BOOKS

1. Potter, N. N. and Hotchkiss, J. H.., "Food Science". Fifth Edition, CBS Publishers and Distributors, New Delhi. 1996.
2. Rao, M. A. and Rizvi, S.S.H., "Engineering Properties of Foods", Marcel Dekker, Inc. New York. 1986.
3. Karel, M., Fennema, O. R. and Lund, D. B., "Principles of Food Science: Part II - Physical Principles of Food Preservation", Marcel Dekker Inc, New York. 1975.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Recall the mechanism of drying and various dehydration techniques

CO2: Familiarize with the concepts of intermediate moisture foods, Pneumatic drying, fluidized bed drying and explosion puffing

CO3: Acquire knowledge on freeze, spray and novel dehydration techniques used in food processing

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2	3	2		3							1
CO2	2	3	3	1	3							1
CO3	2	3	2		3							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT013 COMPUTER APPLICATIONS IN FOOD ENGINEERING

3 0 0 3

MODULE – I **15**

Basics of C program: Introduction on C, Weight Conversion Program and Argument Fibonacci Series Using an Array, History of C, C Program Structure, Variables, Defining Global Variables, Printing Out and Inputting Variables, Constants, Arithmetic Operations Comparison Operators, Logical Operators, Order of Precedence Exercises.
Conditionals, Looping and Iteration, Arrays and Strings, Functions, Structures, Unions, Pointers.

MODULE - II **15**

Basics of C++: An overview of C++ programming, simple program construction, functions, statements, inputs/outputs, preprocessors, comments, variables and manipulators, data types, type conversions, library functions. Objects, classes, inheritance, active data, message passing.
Operators, loops and decisions, statements, structures within structures, structures and classes, enumerated data types.

MODULE - III **15**

Using spread sheet: Starting excel, using menus and dialogue box, use of tool bars, planning a worksheet, Worksheet calculations: use of formulas in calculations, use of auto fill command, copy and paste functions in calculations. Creating a chart- XY chart, line chart, area chart.
Database- use of data analysis command in calculations-Design and developments of simple databases on Chemical and Physical properties of substances. Application in Empirical and Molecular formula calculations

TOTAL : 45

TEXT BOOKS

1. Hanna, O.T. and Scandell, O.C. "Computational Methods in Chemical Engineering", Prentice Hall of India, New Delhi, 1995.
2. Paul singh, R. "computer application in food technology: use of spread sheet in graphical, statistical and process analysis", Academic Press, Inc, San Diego, California,1996.
3. Taxali R.K., "Dbase IV Made Simple", Tata McGraw-Hill, New Delhi, 1991.

REFERENCE BOOKS

1. Myers, A.L. and Seider W.D., "Introduction to Chemical Engineering and Computer Calculations", Prentice Hall, New York, 1976.
2. Jerry, O., and Breneman, G.L., "Spreadsheet Chemistry", Prentice Hall, Englewood Cliffs, 1991.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Recognize the fundamental concepts of C language

CO2: Infer the basic concepts of C++ language.

CO3: Solve problems using spread sheet.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1	1			3							
CO2	1	1			3							
CO3	2	1			3							2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT014 ANALYTICAL INSTRUMENTS IN FOOD INDUSTRIES

3 0 0 3

MODULE – I **15**

Spectrometry: Visible spectrometry and Colorimetry – Theory, Deviations from Beer's Law, Instrumentation (Line diagram alone) and application. Ultra violet spectroscopy – Theory, instrumentation and application. NMR spectroscopy – Quantum description, Instrumentation, Chemical shift, applications and limitations.

Infra red spectroscopy – Theory, Fundamental Vibrations, Overtones, Hook's Law. Instrumentation, Single and Double beam spectrometers, Application and Limitations. Mass spectroscopy – Theory, Spectrometers, Interpretation, some examples, applications and limitations.

MODULE - II **15**

X-Ray, Polarimetry, Refractometry & Conductometry: X-ray diffraction – Mosely's law, K and R bands, Principle, instrumentation, various types of detectors and applications in food products. Flame photometer, auto analyser. Polarimetry and Refractometry – Introduction on specific rotation, optical activity; Principle and instrumentation- Saccharimetery- Analysis of Sugar. Conductometric measurements – Important Laws, Definitions, conductance measurements, applications, Types, advantages and disadvantages of conductometric titrations. Potential measurements, pH, pO_2, pCO_2, $pHCO_3$, pH determination. Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing, capillary, microchip and 2 D electrophoresis.

MODULE - III **15**

Thermal Studies & Chromatographic Techniques: Thermal methods – Thermogravimetry, Differential Thermal Analysis, Differential Scanning Calorimetry - applications.Chromatographic techniques – Introduction and classification. Theory, Instrumentation and Application of Paper chromatography,

Thin Layer Chromatography, Column Chromatography, Gel permeation Chromatography, and ion exchange chromatography, GC, HPLC, GC-MS, LC-MS and GC-FTIR. Solid phase extraction system. Recent Development of Rapid Techniques - electronic nose techniques, flow cytometry, epifluorescene microscopy.

TOTAL : 45

TEXT BOOKS

1. Chatwal, Gurdeep R and Anand, Sham K "Instrumentation Methods of Chemical Analysis", Himalaya Publications, Bombay, 2003.
2. Willard, H.H., Merritt, L.L., Dean, J.A., and Settle, F.A., "Instrumental Methods of Analysis, Seventh Edition": C B S Publishers & Distributors, Delhi, 1988.

REFERENCE BOOKS

1. Skoog Douglas A., West, Donald M., Holler, F. James., and Crouch, Stanley R. "Analytical Chemistry: An Introduction". Seventh Edition: South-Western, Australia, 2000.
2. Banwell, G. C., "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill, New Delhi, 1992.
3. Rouessac, F., "Chemical Analysis: Modern International Method and Techniques", Wiley, New Delhi, 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Know the principle of various spectroscopy analyze different food materials

CO2: Analyze the components of food products using various instrumental methods (x ray diffraction, flame photometers and conductometric methods)

CO3: Acquire knowledge about to analyze the food product by thermal and chromatography methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1	3		2	2							1
CO2		3		2	2							1
CO3		3		2	2							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT015 TECHNOLOGY OF FATS AND OILS

3 0 0 3

MODULE – I **15**

Nutritional Importance Oils and Fats:

Oils and fats – sources, composition. Nutritional importance of fats and oils. Physical properties of fats and oils - color, odor, consistency, melting point, flash point, smoke point. Chemical properties of fats and oils-iodine value, saponification value, free fatty acids, peroxide value. **Properties of Oils and Fats and Preprocessing of oils and fats**:

Industrial production of oils- seed handling and storage – preparation of seed for extraction of oil – Production of palm oil, peanut oil, rice bran oil and soy bean oil Oilseeds-oil content-coconut oil- palm oil- peanut oil, rice bran oil, sun flower oil,- cold pressing and hot pressing. Solvent extraction – removal and recovery of solvent from miscella - removal and recovery of solvent from extracted residue.

MODULE - II **15**

Refining and Production of Vegetable and animal oils: Physical refining, Chemical Refining - Degumming, Hydrogenation, dewaxing / winterization – neutralization - bleaching - deodorizing. Production of Lard, Production of margarine. **Oil Processing Machinery**:Filter press, hydrualic press, expeller – Applications and Operating Principles - Oil deodourizing plant and hydrogenator – Supercritical Technologies for further processing of edible oils – Definition and properties of supercritical fluids – mode of operation – applications in fats and oils processing.

MODULE - III **15**

Edible oils and fats products and Modification of Oils: Modification of oils - Refined oil – fractionation- Blending – Interesterification – Types of Intersterification – Chemical Interesterification – Enzymatic Intersterification – Applications of Interestrification - Margarines and Spreads, Shortenings, Cocoa butter alternative fats, Milk fat and milk fat substitutes - Hydrolysis And Esterification, Edible oils and fats products – Cookling oils, Salad oils and dressings, Fats and oils in bakery products and confectionery lipids. **Packaging and Storage**: Changes during storage of oil – frying of oil – Role of fat or oil in frying – Applications of frying oil – Selection of frying oil – frying process – changes occurring in the food and oil - rancidity - causes - atmospheric oxidation and enzyme action –Quality standards of oil - Packaging of oils and fats.

TOTAL : 45

TEXT BOOKS

1. Hilditch, T. P. “Industrial Chemistry of The Fats and Waxes”, Baillier, Tindall and Cox, London.1943.
2. Wolf Hamm and Richard J. Hamilton. “Edible oil processing”, Blackwell Science Ltd, 2004

REFERENCE BOOKS

1. Weiss, T. J. “Food Oils and Their Uses”, The AVI Publishing Company, Inc, Wesport, Connecticut. 1970.
2. Willians, P. and Nand J. Devine., “The Chemistry and Technology of Edible Oils and Fats”, Pergamon Press, London, 1984.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline the physico-chemical properties and preprocessing steps involved in oils and fats.

CO2: Familiarize with the refining steps and the machineries used in oil extraction.

CO3: Acquire knowledge on modification, packaging and storage of oils.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3											1
CO2	2		3		1							1
CO3	2		3									2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT016 TECHNOLOGY OF SNACK AND EXTRUDED FOODS

3 0 0 3

MODULE – I **15**

Introduction and Ingredients: Scope and current status of expanded and extruded food. Types of snack foods. Nutritional value of different snack foods. Current status of snack food industry in India.

Ingredients – rice, wheat, corn, rye, sorghum. Fats, Oils, Emulsifiers. Sweeteners. Dairy Products, Salt, Nuts and Fruits, Vegetable Ingredients, Flavors and Colors, Starch.

MODULE- II **15**

Equipments: Equipments-Extruding Equipments, Extruder Design and Operation- Equipments for Frying, Baking and Drying.

Specialized Equipment for Popcorn Processing Poppers, Sifters, Coaters, and flaking equipments.

MODULE - III **15**

Cereal Based Snacks and Pasta Products: Cereal based Snacks-based on Popcorn -Factors affecting the quality of Popcorn, Popping procedures puffed Snacks- Formulation and Procedures, Addition of flavors and colors. Ready to eat breakfast cereals. Potato, tortilla and corn based snacks – potato chips, tortilla chips, corn flakes, frozen French fries. Outline of snack food industry.

Pasta products – raw materials. Preparation of raw materials for extrusion. Spaghetti, noodles, macaroni and similar products. Dry and frozen pasta products. Suitable packaging materials. Industrial production of pasta products.

TOTAL : 45

TEXT BOOKS

1. Panda, H., **"**The Complete Technology Book on Snack Foods", National Institute of Industrial Research, Delhi. 2003.
2. R Guy, Campden and Chorleywood., "Extrusion cooking: Technologies and Applications", Food Research Association, UK.2001.

REFERENCE BOOKS

1. Sergio O Serna-Saldivar., **"**Industrial Manufacture of Snack Foods", Kennedys Books Ltd. 2008.
2. Mian N. Riaz., "Extruders in Food Applications", CRC Press, New York, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Make use of specific ingredient based on their functionality.

CO2: Explain the working of equipment used for production of snack and extruded foods.

CO3: Categorize and formulate cereal based snacks and pasta products

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3		2		1	1						1
CO2	3		3		1							1
CO3	3	2	3		1							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT017 TECHNOLOGY OF MILK AND MILK PRODUCTS

3 0 0 3

MODULE – I **15**

Introduction: Coagulated Milk Products; Channa, paneer, classification and manufacturing process of cheese
Fermented milk products; Cream; Processing and types of cream. Butter/Ghee – Manufacture and storage of butter and ghee Manufacturing of Yoghurt, dahi, shrikhand.

MODULE - II **15**

Frozen and Condensed Milk: Frozen Products; Manufacturing of and ice cream; factors affecting the quality of frozen products.
Condensed Milk; Types and factors affecting the quality of condensed milk, storage of condensed milk.

MODULE - III **15**

Dry Milk Products: Methods of drying milk (Drum and Spray drying), factors affecting the quality of dry milk. Introduction to instant non-fat dry milk packaging of dry milk products.
Instantiation of milk and milk products; Flavored milk; toned and double toned milk; imitation milk.

TOTAL : 45

TEXT BOOKS

1. Sukumar De. R. "Outlines of Dairy Technology", Royal, Oxford University, Press, Delhi. 1983.
2. Tufail Ahmed. "Dairy Plant Engineering and Management", CBS Publishers and Distributors, New Delhi. 2001.

REFERENCE BOOKS

1. Ananthakrishnan, C. P. and Sinha, M.N. "Technology and Engineering of Dairy Plant Operations", Laxmi Publications, New Delhi, 1997.
2. Farrall. A.W. "Engineering for Dairy and Food Products", John Wiley & Sons, New York, 1995.
3. Robinson .R.K. "Modern Dairy Technology", Volume. I: Advances in Milk Processing, Elsevier Applied Science Publishers, London, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Appraise knowledge on production of coagulated and fermented milk products.

CO2: Acquire knowledge on frozen and condensed milk products.

CO3: Identify the techniques in the production of dried and instant milk products.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1		2									
CO2	1		3									1
CO3	2	1	3									1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT018 BEVERAGE TECHNOLOGY

3 0 0 3

MODULE – I **15**

Introduction: Introduction – Alcoholic and non-alcoholic Beverages, Status of beverage Industries in India, types of beverages, sources, nutritional and therapeutic benefits.

Raw materials preparation – malts, adjuncts and enzymes, preservatives, sweeteners, barley, Aroma Compounds. Pretreatment of the raw materials, Fermentation, Distillation Maturing, Maturation and ageing, Blending and coloring.

MODULE - II **15**

Non Alcoholic Beverages: Natural, Fruit based beverages, Fruit Juices, Concentrated Fruit Juices and Fruit Nectars, tropical fruit juices, Synthetic/Artificial beverages.

Carbonated beverages- Carbonation, Properties of carbon dioxide, Measurement of carbonation, Fruit drink regulations.

MODULE - III **15**

Alcoholic Beverages: Types of alcoholic beverages, Brewing - Milling and mashing, wort separation systems, Wort clarification, removal of yeast and beer recovery.

Sedimentation and fining, centrifugation, filtration. Beer filtration cooling and aeration, Fermentation, The processing of beer, Wine – types, production. Whisky, rum.

TOTAL : 45

TEXT BOOKS

1. Yiu H. and Hui, Lisbeth**.,** **"**Handbook of Food and Beverage Fermentation Technology", CRC Press, New York, 2004.
2. Crueger, W. and Crueger A. "Biotechnology: A Textbook of Industrial Microbiology", Science Tech. Madison, USA.1984.

REFERENCE BOOKS

1. Crueger, W. and Crueger A. "Biotechnology: A Textbook of Industrial Microbiology", Science Tech. Madison, USA. 1984.
2. Bamforth, Brewing., "New Technologies", Woodhead Publishing Limited. England, 2006.
3. Paquin P, "Functional and Speciality Beverage Technology", Woodhead Publishing Limited, England, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: List the types, nutritional benefits of beverages and raw materials for beverages

CO2: Infer the production of non-alcoholic and carbonated beverages.

CO3: Elaborate the steps involved in the production of alcoholic beverages

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	2	2		1	2						
CO2	3	2	3		2	2						1
CO3	3	2	3		2	1						1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT019 CANE SUGAR TECHNOLOGY

3 0 0 3

MODULE– I **15**

Composition and Raw Sugar Manufacturing

Composition of sugarcane - Reactions of juice constituents - Physicochemical properties of sucrose - Quality criteria of white sugar and its commercial grades

Extraction of juice, extraction yields, drying and uses of Bagasse, Purification of juices-juice filtration and chemical purification, Clarification stages, Lime addition, pH control.

MODULE - II **15**

Treatment of Clarified Juice: Evaporation-multiple effect evaporators, Vacuum pans - A, B and C masseecuites - Crystallization theory - Nucleation - seeding techniques - Crystal growth - Effects of nonsugars - Crystal size distribution. Conglomerates - Principles of supersaturation and crystal content measurement - Crystallization techniques - Batch evaporating crystallization - Continuous evaporating crystallization.

MODULE - III **15**

Refining and Byproducts: Affination- clarification- carbonation – sulphitation – phosphitation - centrifugation: dewatering of sugar Drying, bagging and storage - Factors affecting sugar processing.

Drying and uses of Bagasse - Back strap Molasses - Characteristics of Molasses - Direct Utilization of Molasses -Distilling Industries - Applications in animal feed – Biogas – Biofertilizers production.

TOTAL : 45

TEXT BOOKS

1. Baikow, V.E. “Manufacturing and Refining of Raw Cane Sugar”, Volume. I & II, Elsevier Publishing Company, New York, 1967.
2. Paturau, J. M.. **“**By-Products of the Cane Sugar Industry.” Elsevier publishing company, New York, 1989.

REFERENCE BOOKS

1 Heriot T, H. P., “The Manufacture of Sugar From The Cane and Beet”. Read Books, New York, 2007.
2. Ram Behari Lal and Mathur. “Hand book of Cane Sugar Technology”. Oxford and IBH Publishing Company, New Delhi. 1995.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Familiarize with the composition, extraction and clarification of sugarcane juice.

CO2: Identify the different techniques used for crystallization of sugar.

CO3: Obtain knowledge about refining process and by-product utilization

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2		1									
CO2	2	2	3									1
CO3	2		3			2	2					1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT020 FERMENTATION TECHNOLOGY

3 0 0 3

MODULE – I **15**

Role of Downstream Processing: Introduction and importance of downstream processing.Problems and requirements of downstream processing. Media Formulation - Preparation of Complex and synthetic media. Sterilization-air sterilization, media sterilization. Batch/continuous fermentation, Maintenance of aseptic conditions. Characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high Value products).

Physico-chemical basis of bio-separation processes. Strain Development - Various techniques of modifying the strains for increased production of industrial products. Use of chemicals, UV rays, genetic engineering to produce newer strains.

MODULE - II **15**

Fermenters Design: Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, bubble aeration, mechanical agitation, correlation between mass-transfer coefficient and operating variables. Fementers' design, Basic functions of a fermenter, Fermentation vessels, operation - measurement and control.

Laboratory and plant fermenters; shake flasks and advantages; laboratory fermentation systems with various controls and sampling and data collection provisions; cooling systems; inoculation, temperature and pH control systems; scale-up of fermentation process.

MODULE - III **15**

Production of Fermented Products: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand, etc., Soya based products like soya sauce, natto, etc., Cocoa, Cheese etc.; control of quality in such products. Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc,), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc.

Fermentative Production of Organic acids like (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Antibiotics (Erythromycin, Penicillin), Polysaccharides (Dextran, Xanthan) etc.; steroids transformation and industrial enzyme production by micro-organisms; process descriptions and key controls for optimal production.

TOTAL : 45

TEXT BOOKS

1 Stanbury, P.F, and Whitake S, A. "Principles of Fermentation Technology", Pergamon Press, Oxford, 1984.
2 Jey, J.M. "Modern Food Microbiology", CBS Publishers and Distributors. New York. 1987.

REFERENCE BOOKS

1 Gutierre, Gustavo F., "Food Science and Food Biotechnology", GRC Press, New York, 2003.
2 Crueger, W. and Crueger A. "Biotechnology: A Textbook of Industrial Microbiology", Science Tech. Madison, USA. 1984.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Interpret the role of downstream processing in food industries.

CO2: Infer the fermentation process and fermenter for food process applications.

CO3: Identify processes involved in the production of fermented products.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	2		3		2		1					
CO2	2		3		2		1					
CO3	2		3		2		1					

3 – Substantial, 2 – Moderate, 1 – Slight

11FT021 FOOD ADDITIVES AND NUTRACEUTICALS

3 0 0 3

MODULE – I **15**

Introduction & Types of Additives: Introduction – food additives – Types – natural and synthetic, chemical properties, role of additives in foods, Risks and benefits, levels of additions in individual products. Preservatives - Acidulants, Humectants, Emulsifiers and gums, Antioxidants, Dough conditioners - flour improvers, Fat substitutes and replacers, Enzymes, Nutritional additives.

Colorants – Classification - Natural and artificial, Colorants as Food Additives, Flavorings - Flavor enhancers, Sweeteners – Natural and synthetic, Chelating agents, anti-browning agents.

MODULE - II **12**

Safety, Regulation and Quality Standards: Determination of the limit for addition – NOEL – Toxicity data – Method of determining toxicity – LD50,– PFA, FDA, FPO regulations – GRAS additives.

Safety limits of Food additives; Risk assessment and risk benefit Indices of human exposure, acute toxicity, mutagencity and carcinogenicity, reproductive and developmental toxicity, teratogenicity, neurotoxicity and behavioural effect, immunotoxicity.

MODULE - III **18**

Nutraceuticals and its Bioprocessing Technology: Definition of Nutraceuticals and difference from nutrients. Traditional Health Sciences including Ayurveda, Unani, Chinese etc. Benefits of Nutraceuticals in controlling certain diseases; Natural Occurrence of certain phytochemicals and their usefulness in functional foods with following examples: Antioxidants and Flavonoids; Omega-3 Fatty Acids; Carotenoids; Dietary Fibre; Phytoestrogens; Glucosinolates

Pasteurisation Sterilization with high pressure – ultrahydrostatic pressure treatment, dense carbon-di-oxide treatment, encapsulation of neutraceuticals – materials, mechanical processes and chemical based processes, nanoencapsulation; packaging requirements and practices for functional foods; distillation and dehydration technologies to retain bioactive compounds

TOTAL : 45

TEXT BOOKS

1 Vaclavik, V.A. and E. W .Christian "Essential of Food Science", 2nd Edition, Springer, 2005
2 Wildman, Robert E.C., "Handbook of Nutraceuticals and Functional Foods", CRC Press, New York, 2001.

REFERENCES BOOKS

1 Clydesdale, Fergus M., "Food Additives: Toxicology, Regulation, and Properties", CRC Press, New York, 1996.
2 Lockwood, Brian, and Rapport, Lisa, "Nutraceuticals: A Guide for Healthcare Professionals", Pharmaceutical Press, 2007.
3 Millstone, Erik, "Food Additives", Penguin, New Delhi, 1986.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify the types and properties of food additives.

CO2: Recognize the hazards and safety limits of food additives.

CO3: Outline the technology for the production of functional foods and nutraceuticals.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1		3	2									1
CO2		2	2			3						1
CO3		2	3									1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT022 ENZYMES IN FOOD PROCESSING

3 0 0 3

Objective: To introduce major features of enzymes and properties. To provide a sound background for the application of enzymes for processing and improvement of foods with focus on the major food groups.

MODULE – I **15**

Enzyme kinetics, Inhibitors and Environmental Effects: Enzyme-Classification and Nomenclature, Units of Activity, General Characteristics, Storage & Handling. Enzyme Kinetics - Michaelis Menden Equation, Linear Plots / Km and Vmax. Initial Rate Measurements, Progress Curve Measurements, Fixed Time Assays.

Enzyme inhibition –Irreversible, Reversible – Competitive, Noncompetitive, Uncompetitive. Effect of pH, Temperature, Aqueous Environment - Water Activity, Ionic Strength, Freezing - Catalytic Activity, Stability.

MODULE - II **15**

Enzyme Isolation, Immobilization and Enzyme Engineering: Enzyme isolation, purification. Enzyme immobilization: general concepts, methods of immobilization, kinetics of immobilized enzymes, industrial application of immobilized enzymes- Bioreactors. Use of enzymes in analysis-development of enzyme based biosensors.

Enzyme Engineering - Prediction of enzyme structure, design and construction of novel enzymes. Industrial application - use of whole organisms as a source of enzyme--merits and demerits of isolated enzymes in industrial processes.

MODULE - III **15**

Enzymes in Food Processing: Glycosidic Hydrolases – Amylases, Cellulases, β-Fructosfuranosidase, β-Galactosidase, Pectic Enzymes - Pectinesterase, Polygalaturanases, Pectic Lyases. Proteolytic Enzymes -Aspartic Proteases, Sulfhydral Proteases, Serine Proteases, Metallic Proteases. Oxidoreductases - Glucose oxidase, Lipoxygeanase, Lipase

Enzymes for Dairy Product Processing - Microencapsulated and immobilised enzymes-their application in accelerated ripening of cheese;, Carbohydrates & Lipids - Starch, High Fructose corn syrup, functional oligosaccharides, tagatose; modification of acyl glycerols, trans-free fats, coco butter substitutes, Production of Flavours - Production of Mono-sodium glutamate, aspartame; vanilla extraction.

TOTAL : 45

TEXT BOOKS

1 Rastall, Robert "Novel Enzyme Technology for Food Applications", CRC / Woodhead Publications, 2007.

2 Schmidl, Mary K. and Theodore P. Labuza "Essentials of Functional Foods", Aspen Publications, 2000

REFERENCES BOOKS

1 Vaclavik, V.A. and E.W. Christian "Essentials of Food Science", 2nd Edition, Springer, 2005

2 Helmutuhling, "Enzyme Technology", John Wiley & Sons, New York, 1998

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Acquire knowledge on enzyme kinetics and influence of environmental factors on enzyme activity.

CO2: Identify the methods for enzyme isolation and immobilization and understand the concepts of enzyme engineering.

CO3: Employ suitable enzymes in food processing.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3	3	2									
CO2	1	3	3									
CO3	1	3	3	2		1						2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT023 ADVANCED SEPARATION TECHNIQUES

3 0 0 3

MODULE– I **15**

Separation Process: Review of conventional processes. Selection of unit operations and processes- Principal type of Reactors- Screening – Mixing – Coagulation and Flocculation – Flow equalization. Sedimentation – Type of settling – Removal ratio – Clarifier – thickener – Column flotation – air floatation

Recent advances in separation techniques based on size, surface properties, ionic properties and other ssucpecial characteristics of substances. Process concept, Theory and equipment used in cross flow filtration, cross flow electro filtration, dual functional filter, Surface based solid – liquid separations involving a second liquid, Sirofloc filter.

MODULE– II **15**

Membrane Separation and Adsorption

Membrane Separation : Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fibre membrane reactors and their relative merits, Commercial pilot plant and laboratory membrane permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis, Economics of membrane operations, Ceramic membranes.

Adsorption: Mechanism, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno Chromatography. Types of equipment and commercial process,

Recent advances and process economics.

MODULE– III **15**

Ionic Separation and other Techniques

Ionic Separation: Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electrodialysis, Commercial processes.

Separations involving lyophilisation, Pervaporation and permeation techniques for solids, liquids and gases, Industrial viability and examples, Zone melting, Adductive crystallization, Other separation processes, Supercritical fluid extraction, Oil spill Management , Industrial effluent treatment by modern techniques.

TOTAL : 45

TEXT BOOKS

1. Lacey, R.E. and Looeb S. “Industrial Processing with Membranes”, Wiley – Inter Science, New York, 1972.
2. King, C.J. “Separation Processes”, Tata McGraw–Hill Publishing, New Delhi, 1982.

REFERENCE BOOKS

1. Schoen, H.M. “New Chemical Engineering Separation Techniques”, Inter-science Publishers, 1972.
2. Roussel Ronald W., “Handbook of Separation Process Technology”, John Wiley, New York, 1987.
3. Kestory, R.E. “Synthetic Polymeric Membranes”, Wiley. Interscience, New York, 1985.
4. Osadar, Varid Nakagawal, “Membrane Science and Technology”, Marcel Dekkar 1992.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Infer the concepts of separation techniques.

CO2: Acquire knowledge on separation by membrane and adsorption.

CO3: Familiarize with ionic separation and other commercial process.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3											1
CO2	3	2				2						1
CO3	3	2				2						2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT024 DOWN STREAM PROCESSING OF BIO PRODUCTS

3 0 0 3

MODULE – I **15**

Role of Downstream Processing in Biotechnology: Introduction and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. characteristics of biological mixtures. Physico-chemical basis of bio-separation processes. Recent development in product isolation.process design criteria for various classes of bioproducts (high volume, low value products and low volume, high Value products).

MODULE - II **15**

Primary Separation And Recover Process: Cell disruption methods for intracellular products, removal of insoluble, biomass separation techniques, flocculation and sedimentation, centrifugation and filtration methods. Theory, design and configuration of separation equipment applications.
Enrichment Operations precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction), in situ product removal, integrated bio processing.

MODULE - III **15**

Product Resolution / Fractionation: Chromatographic techniques- Paper, TLC, Adsorption, Ion exchange,Gel filtration,affinity chromatographic separation processes, GC, HPLC, FPLC, Chromato focusing electrophoretic separations.
Emerging Technologies Dialysis, Crystallization Pervaporation, super liquid extraction foam based separation case study with examples for processing of Two Industrial Products (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Total : 45

TEXT BOOKS

1. Wankat PC. Rate controlled separations, Elsevier, 1990.
2. Belter PA and Cussler E. Bioseparations, Wiley 1985.

REFRENCE BOOKS

1. Product Recovery in Bioprocess Technology, BIOTOL.' Series, VCH, 1990.
2. Asenjo J.M. Separation processes in Biotechnology, 1993, Marcel Dekkere Inc.
3. Bioseparations by Siva Shankar PHI publications

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Recognize the role of downstream processing in biotechnology.

CO2: Acquire knowledge on recovery and enrichment processes.

CO3: Identify the techniques for product resolution

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3											1
CO2	3											1
CO3	3				3							1

3 – Substantial, 2 – Moderate, 1 – Slight

11FT025 FOOD BIOTECHNOLOGY

3 0 0 3

MODULE – I **15**

Basic Concepts in Biotechnology: Basic concepts, Advances and Trends in Food Biotechnology. Review of Nucleic Acid Biochemistry. Genetic Engineering Techniques- Recombinant DNA Techniques and Cloning Strategies. Biotechnological approaches to improve nutritional qualities and shelf life of fruits and vegetables, live stock, poultry and fish products.
Microorganisms of industrial importance: isolation, cultivation and preservation techniques; strain improvement. Methods of inoculums development.

MODULE - II **15**

Plant Tissue Culture & Genetic Engineering: Basic of plant tissue culture, secondary metabolites production and uses, Plant genetic engineering – gene transfer methods – plant cloning vectors, Agrobacterium technology, Nitrogen fixation – Molecular biology Applications of plant biotechnology.
Techniques in crop improvement, molecular breeding, commercialization of plant biotechnology, plant pharmaceuticals, Plant cell bioreactors – edible vaccine, Bt corn, Golden rice

MODULE - III **15**

Molecular Diagnostic Tools & GM Foods – Social and Ethical Issues Rapid detection techniques for food borne pathogens and their toxins; In-vitro evaluation of bacterial toxins by immunological techniques like slide agglutination, tube agglutination, gel diffusion assay; Genetic based diagnostic systems - Polymerase Chain Reaction (PCR). Micro array diagnostic methods to detect pathogens, pesticides, and toxins in the raw materials and food.
Potential Impact of Biotechnology on Food Industries. GM foods and food security- Safety aspects and social acceptance - Ethical issues. GMOs- current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects.

TOTAL : 45

TEXT BOOKS

1 Gutierre, Gustavo F., "Food Science And Food Biotechnology", GRC Press, New York, 2003.
2 Joshi, V.K. and Pandey, A.. "Biotechnology. Food Fermentation", Volume. I & II, Education Publishing, New Delhi, 1999.

REFERENCE BOOKS

1 Bielecki S., Ed., Polak J., J. an d Bielecki, Tramper S., "Food Biotechnology", Elsevier Science Publishing Company, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Express the basic concepts of recombinant technology and its applications.

CO2: Acquire knowledge on plant tissue culture and genetic engineering.

CO3: Apply the molecular diagnostic tools in food analysis and understand the importance of GM foods

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	3											
CO2	2	1	1		3	2						
CO3	1	3	2	1	3	2	1					

3 – Substantial, 2 – Moderate, 1 – Slight

11GE011 ENTREPRENEURSHIP DEVELOPMENT

(Common to all Engineering and Technology branches except Civil Engg.)

3 0 0 3

MODULE – I **15**

Entrepreneurship Concepts: Meaning and Concepts of Entrepreneurship – Definition and Characteristics of an Entrepreneur – Entrepreneurial Process – The scope of Entrepreneurship in India. Entrepreneurial Motivation – Factors creating Entrepreneurship – Classification of Entrepreneurs – Intrapreneurship - Barriers to Entrepreneurship – Creativity, Innovation & Entrepreneurship - Role of Entrepreneurship in Economic Development.

MODULE – II **15**

Business Plan: Business Planning Process – Idea generation, Environmental Scanning, Feasibility Analysis, Drawing Functional Plan - Marketing Plan – Production/Operations Plan –Organizational Plan – Financial Plan – Human Resource Plan – Project Report Preparation , Evaluation, Control and Review.

MODULE – III **15**

Managing a Small Business: Sources of Finance - Institutions Supporting Entrepreneurs - EDPs. Small Scale Industry – The Strengths and Weaknesses of Small Business - Growth strategies – Sickness - Evaluation, Symptoms, Causes and Assessment – Rehabilitation of Sick Industries.

TOTAL :45

TEXT BOOKS

1. Madhurima Lall and Shikha Sahai, " Entrepreneurship", Excel Books, New Delhi, 2006
2. S.S.Khanka, " Entrepreneurial Development", S.Chand & Company Ltd, 2005

REFERENCE BOOKS

1. Robert D Hisrich, Michael P Peters and Dean A Shepherd, "Entrepreneurship", Sixth Edition, Tata McGraw Hill, New Delhi, 2009.
2. Mary Coulter, "Entrepreneurship in Action", Second Edition, Prentice Hall of India, New Delhi, 2005.
3. Jain P.C., "Handbook for New Entrepreneurs", Oxford University Press, Oxford, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate knowledge of entrepreneurship concepts

CO2: plan various aspects of business activities

CO3: manage to start and run small business.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1			1		3	3	3		3		
CO2	1			1		3	3	3		3		
CO3	1			1		3	3	3		3		

3 – Substantial, 2 – Moderate, 1 – Slight

11FT026 FOOD LAWS & SAFETY

3 0 0 3

MODULE – I **18**

Historical Perspectives Including Necessity of Food Laws: Establishment of US Pure Food Law in early 1900s and of Food & Drug Administration to enforce safety of food products; Urbanisation of population and necessity of processed and preserved foods and the necessity of ensuring quality of food to prevent adulteration. Prevention of Food Adulteration Act 1954 & Rules 1955 established in India to enforce safety and purity of food products; Various aspects of defining adulteration, taking samples of food for analysis by public analyst, prosecution for adulteration and punishment;

Standards of various food products; FPO; Infant Milk Substitute Act; Laws relating to vegetable oils; Use of permitted additives like colours, preservatives, emulsifiers, stabilisers, antioxidants etc. Food Safety & Standards Act 2006 and the provisions therein; Integrated Food Law - Multi departmental - multilevel to single window control system, consumer protection Act.

MODULE - II **12**

Food Safety in Processing : Building and equipment design; microbiological quality of water, air; Safety in food procurement, storage, handling and manufacture; Food safety in retail food businesses; international food service operators, institutional food service operators; application of the principals of modern hygiene; Food handlers, habits, clothes, illness;

Training & Education for safe methods of handling food; cleaning and sanitization of processing plants; principles of cleaning and sterilization ; sterilization & disinfection- different methods used- detergents, heat, chemicals; selecting and installing equipment; Cleaning of equipment and premises. Safety limits of sanitizers; pest control; management and disposal of waste.

MODULE - III **15**

Food Safety Management Systems : Food safety and quality management systems- Physical, chemical and Microbial hazards and their control in food industry; Good laboratory practice (GLP); Quality systems standards including ISO; - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); good manufacturing practices (GMP);

Good Manufacturing Practice and HACCP; Surveillance networks, Consumer and food service operator education; GM Foods, safety and labeling; International Food Standards ISO 9000 and related standards; Impact of food safety on global trade.

TOTAL : 45

TEXT BOOKS

1 Rees, Naomi and David Watson "International Standards for Food Safety", Aspen Publication, 2000.
2 Schmidt, Ronald H. and Rodrick, G.E. "Food Safety Handbook", Wiley Interscience, UK, 2005.

REFERENCE BOOKS

1 Mehta, Rajesh and J. George "Food Safety Regulations, Concerns and Trade : The Developing Country Perspective", Macmillan, 2005
2 "The Prevention of Food Adulteration Act, 1954", Commercial Law Publishers India) Pvt. Ltd.,

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Appraise the necessity of food laws and standards

CO2: Take part in framing the safety procedures for handling and processing of foods.

CO3: Apply food safety and quality management systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1		1			3		3				2
CO2	2	2	2	2	2	3	2	2				2
CO3	2	2	2	2	2	3	2	2				2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT027 FOOD PROCESS EQUIPMENT DESIGN

3 0 0 3

MODULE – I **15**

Introduction and Construction Requirements: Material of construction: Introduction to material selection; Material properties; Environmental effects on material selection; Mechanical properties & strength of materials.
Design basis: Design code; Design pressure, stress & factor of safety; Corrosion allowance; Weld joint efficiency factor; Design loadings; Criteria of failure.

MODULE - II **15**

Design of Pipe, Process Vessel and Supports: Design of pipe and pipe fittings. Process vessels under internal and external pressure; Design of attachments and closures;
Design of flange connections & threaded fasteners; Design of supports; Bracket or Lug supports, Leg Supports, Skirt Supports

MODULE - III **15**

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

TOTAL : 45

TEXT BOOKS

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

REFERENCE BOOKS

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

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Familiarize with the construction materials and design fundamentals.

CO2: Design pipes, process vessels and supports.

CO3: Design the process equipments.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1		1									1
CO2	2	2	3			1						2
CO3	2	3	3			1						2

3 – Substantial, 2 – Moderate, 1 – Slight

11FT028 BYPRODUCTS UTILIZATION IN FOOD AND AGRO INDUSTRIES

3 0 0 3

MODULE – I **15**

Byproducts From Agro Industries and Processing, Utilization of Rice Bran: Agro industries - Classification and availability, characteristics, valuable constituents, composition and utilization. Different sources of wastes from food industries and their availability in India-nature of different waste. Byproducts of Agro-industries - identification in various agro-industries - rice mill, oil mill, cattle feed mill, fruits and vegetables, poultry, tuber crops, wheat and pulse mill.

Rice bran - stabilization - methods - recent techniques in rice bran stabilization. Storage of rice bran - effect of stabilization on storage - quality of rice bran on storage. Extraction of rice bran oil - solvent extraction process - unit operations. Rice bran and oil - constituents and compositions - oil refining - processes - alkali process. Byproducts of oil refining - fatty acids/soap stock, wax and gum - characteristics. Utilization of fatty acids/soap stock wax and gum for the production of soap, cream and polish. Rice germ and broken rice - production of starch and infant food - uses of starch at textile, animal feed and pharmaceutical industries**.**

MODULE - II **15**

Processing and Utilization of Sugar and Tuber Crop Industry Byproducts: Byproducts of sugar industry - sugarcane tops, bagasse, molasses and press mud - animal feed from sugarcane tops and bagasse - process. Molasses - use as sweetener and binder in cattle feed - liquid urea and molasses in animal feed. Press mud - source of microbial protein - ingredient in animal feed. Waste from tuber crops - effluent safe disposal- effluent treatment plant- waste recycling plant - feasibility report for food industries using food waste and by products.

MODULE- III **15**

Processing and Utilization of Byproducts From Fruits, Vegetables and Coir Fibre Industries: Byproducts of fruits and vegetables based agro-industries - mango seed kernel -extraction of fat and de-oiled mango seed - meal - use in animal feed. Pine apple waste - production of citric acid and use in animal feed formulation. Natural dyes - The extraction step - Sources for natural dyes & results of a screening for sources in food processing - Natural dyes from food processing wastes & representatives examples - Future trends. By products of coir fibre industries - extraction of coir fibre - white fibre and brown fibre - process - export. Products from fibre and export. Coir fibre industries - coir pith - utilization as mature, fuel and soil conditioner. Manufacture of particle board from coir pith.

TOTAL : 45

TEXT BOOKS

1. Chahal. D.S., 'Food, Feed and Fuel from Biomass", Oxford & IBH Publishing, New Delhi, 1991.
2. Sheth, B.M and Metha B.V., "Hand Book on Rice Bran Processing and Utilisation of Products", The Solvent Extractors Association of India, Mumbai, 1987.

REFERENCE BOOKS

1. Waldron, K., "Handbook of Waste Management and Co-Product Recovery in Food Processing", Volume. 1, Woodhead publishing Co. England, 2007.
2. Ranjhan, S.K., "Agro-Industrial Byproducts and Non-conventional Feeds for Livestock Feeding", Indian Council of Agricultural Research, New Delhi. 1990.
3. Srivastava P.K., Maheswari R.C and Ohja, T.P., "Biomass Briquetting and Utilization", Jain Brothers, New Delhi.1995.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify the sources of wastes from food and agro industries.

CO2: Outline the by-product utilization of rice bran.

CO3: Explain the by-product utilization of sugar and tuber crop industry.

CO4: Summarize the by-product utilization of fruits, vegetables and coir industry.

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1		1	1		2	3	2					1
CO2		1	2		2	3	3					1
CO3		1	2		2	3	3					1
CO4		1	2		2		3					1

3 – Substantial, 2 – Moderate, 1 – Slight