PAAVAI ENGINEERING COLLEGE, NAMAKKAL - 637 018

(AUTONOMOUS)

B.Tech FOOD TECHNOLOGY

CURRICULUM

REGULATIONS 2016

(CHOICE BASED CREDIT SYSTEM)

(For the candidates admitted during the Academic Year **2018- 2019**)

SEMESTER III

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	BS	MA16301	Transforms and Boundary value problems	3	2	0	4
2	PC	FT16301	Food Process Calculations	3	0	0	3
3	PC	FT16302	Food Science and Nutrition	3	0	0	3
4	ES	CM16305	Fluid Flow Process	3	0	0	3
5	BS	CH16301	Environment Science and Engineering	3	0	0	3
6	ES	EE16307	Electrical Machine Drives and Sensors	3	0	0	3
PRACTICALS							
7	ES	CM16306	Fluid Mechanics Laboratory	0	0	4	2
8	PC	FT16303	Microbiology Laboratory	0	0	4	2
9	HS	EN16301	Business English Course Laboratory	0	0	2	1
			TOTAL	**18**	**02**	**10**	**24**

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1	BS	MA16403	Probability and Statistics	3	2	0	4
2	PC	FT16401	Analytical Instruments in Food Industries	3	0	0	3
3	PC	FT16402	Fermentation Technology	3	0	0	3
4	PC	FT16403	Engineering Properties of Food Materials	3	0	0	3
5	ES	CM16405	Chemical Engineering Thermodynamics	3	0	0	3
6	ES	CM16406	Process Heat and Mass Transfer	3	0	0	3
PRACTICALS							
7	PC	FT16404	Instrumental Methods of Analysis Laboratory	0	0	4	2
8	PC	FT16405	Food Fermentation Laboratory	0	0	4	2
9	ES	CM16407	Heat and Mass Transfer Laboratory	0	0	4	2
			TOTAL	**18**	**02**	**12**	**25**

MA16301 TRANSFORMS AND BOUNDARY VALUE PROBLEMS 3 2 0 4

COURSE OBJECTIVES

To enable students to

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

UNIT I FOURIER SERIES 15

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

UNIT II FOURIER TRANSFORMS 15

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms –Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 15

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

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 15

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 15

Z-transforms – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- have gained a well founded knowledge of Fourier series, their different possible forms and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
- have grasped the concept of expression of a function, under certain conditions, as a double integral leading to identification of transform pair and specialization on Fourier transform pair, their properties.
- have obtained capacity to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them and interpret the results.
- be capable of mathematically formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.

- have learnt the basics of Z – transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z – transform technique bringing out the elegance of the procedure involved.

TEXT BOOKS

1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Narayanan S., Manickavasagam Pillai.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" ,Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998

REFERENCES

1. Larry C. Andrews, Bhimsen K. Shivamoggi, "Integral Transforms for Enginears", SPIE Optical Engineering press, Washington USA (1999).
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi (2010).
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
4. Erwin Kreyszig., "Advanced Engineering Mathematics" 10th Edition,Wiley Publications
5. Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.

WEB LINKS

1. https://www.youtube.com/watch?v=coe-UA5ONI0
2. https://www.youtube.com/watch?v=gZNm7L96pfY
3. http://172.16.100.200/NPTEL/displayweb.html?type1=111103021%2F35.pdf
4. https://www.youtube.com/watch?v=4GHY8sRKPaU
5. http://172.16.100.200/NPTEL/displayweb.html?type1=111104031%2Flectures.pdf%23page%3D101

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	2	1	1	-	1	-	-	1	2	3
CO2	2	2	2	2	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	2	-	-	1	1	1	-	2	2	3
CO4	3	3	2	2	2	-	-	-	1	1	-	2	2	3
CO5	2	2	1	1	1	-	-	-	-	-	1	2	2	3

FT16301 FOOD PROCESS CALCULATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to,

- help the students develop the concepts of different unit conversions.
- understand the material balance and energy balance in different engineering systems by applying different mathematical interpretations.
- know about the composition of mixture and solutions.
- get knowledge about the calculations of pressure, volume and temperature using ideal gaslaw.
- relate the air requirement for combustion calculations of fuels.

UNIT I UNITS AND DIMENSIONS, FUNDAMENTAL CALCULATIONS 9

Basic and derived units, Unit conversions, Use of model units in calculations, Methods of expression, Compositions of mixture and solutions. Ideal and real gas laws , Gas constant , Calculations of pressure, volume and temperature using ideal gas law; Use of partial pressure and pure component volume in gas calculations, Applications of real gas relationship in gas calculation.

UNIT II MATERIAL BALANCE 9

Stoichiometric principles, Material balance without chemical reaction, Application of material balance to unit operations like distillation, Evaporation, Crystallization, Drying and Extraction.

UNIT III RECYCLE OPERATIONS 9

Recycle stream, Block diagram, Purging operations, Purge ratio, Recycle ratio and Purge stream;Humidity and Saturation- Calculation of absolute humidity, Molal humidity, Relative humidityandPercentage humidity, Wet and dry bulb temperature, Dew point; Humidity chart usage.

UNIT IV ENERGY BALANCE 9

Heat capacity- Heat capacity of solids, Liquids, Gases and solutions, Use of mean heat capacity in heat calculations; Sensible heat and latent heat, problems involving sensible heat and latent heats, evaluation of enthalpy; Standard heat of reaction, Heats of formation, Combustion, Solution, Mixing, Calculation of standard heat of reaction, Effect of pressure and temperature on heat of reaction; Energy balance for systems without chemical reaction.

UNIT V COMBUSTION 9

Combustion of solids, Liquid and Gas; Determination of NHV and GHV; Determination of composition by Orsat analysis; Calculation of excess air, Theoretical oxygen requirement.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply different systems of units and dimensions, estimate compositions of mixtures and solutions.

- apply material balance for different unit operations.
- apply material balance for recycle operations and perform humidification calculations.
- perform energy balance calculations.
- determine the GHV, NHV and composition of fuels.

TEXT BOOKS

1. Gavhane K.A., "Introduction to Process Calculations (Stoichiometry)", 22nd Edition, Nirali Prakashan Publications, Pune, 2009.
2. Venkataramani V. and Anantharaman N., "Process Calculations", Prentice Hall of India, New Delhi, 2003.

REFERENCES

1. Bhatt B.L. and Vora S.M., "Stoichiometry", 4th Edition, Tata McGraw-Hill PublishingCompany, New Delhi, 2004.
2. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", 6thEdition, Prentice Hall of India, New Delhi, 2003.
3. Narayanan K.V. and Lakshmikutty B., "Stoichiometry and Process Calculations, PrenticeHall of India, New Delhi, 2006.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2
CO2	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	-	-	-	-	-	-		3	2	3
CO5	3	3	3	3	2	1	-	-	-	-	-	3	3	3

COURSE OBJECTIVES

To enable students to,

- demonstrate transferable and employability skills in family, community, and work/career settings.
- assess principles to maximize nutrient retention in prepared foods; the effects of nutrients on health, appearance, and peak performance.
- evaluate factors that affect food safety, from production through consumption.
- evaluate consumer policies, information and services, including those that relate to consumer rights and responsibilities.
- appraise sources of nutrition information, including food labels, related to health and wellness.

UNIT I OVERVIEW OF NUTRITION 9

An Overview of Nutrition- Definition, Six classes of nutrients, RDA, Nutritional status and its assessment, Nutritional requirement; Malnutrition – Over nutrition and under nutrition; Anatomy and physiology of the digestive tract, Mechanical and chemical digestion, Absorption and transport of nutrients.

UNIT II CARBOHYDRATES 9

Carbohydrates - Sugars, Starch and Fibres, Digestion and absorption of carbohydrates, Lactose Intolerance, Glycemic and non-glycemic carbohydrates, Recommendations of sugar intake for health, Health effects of fibre and starch intake, Artificial sweeteners; Nutrition and Diabetes, GTT.

UNIT III LIPIDS AND PROTEINS 9

Lipids - Food sources, Lipid digestion, Absorption and transport, Functions of the triglycerides, essential fatty acids, n-3 and n-6 fatty acids, trans fatty acids; Medium Chain Triglycerides, Phospholipids and sterols; Health effects and recommended intakes of lipids; Protein – Amino acid, Digestion and absorption of proteins, Functions of proteins; Protein quality, Methods of assessing protein quality; Recommended intakes of proteins; Protein and amino acid supplements; Protein Energy Malnutrition - Marasmus and Kwashiorkor..

UNIT IV ENERGY BALANCE AND BODY COMPOSITION 9

Calorific value of foods: Definition, Units, Bomb calorimeter; Energy requirements: Basal metabolism, Specific dynamic action of foods, Energy balance, Direct and indirect calorimetry, Physiological energy value of foods. Body composition - Body weight and body composition; Health implications; Obesity, BMR and BMI calculations; Weight Control - Fat cell development; Hunger, Satiety and satiation; Dangers of weight loss; How to identify unsafe weight loss schemes; Treatment of obesity; Attitudes and behaviours toward weight control.

UNIT V NUTRITION FOR AGE GROUPS 9

Factors to be considered in meal/menu planning; Pregnancy - nutrition requirements and food selection. Lactation - nutritional requirements; Infancy - nutritional requirements, Breast feeding, Infant formula; Introduction of supplementary foods; Early childhood. (Toddlers and Preschoolers) - Growth and nutrient needs, Nutritional related problems, Feeding Pattern; School children - Nutritional requirements, Importance of snacks, School lunch; Adolescence - Growth, Nutrient needs, Food choice, Eating habits, Factors influencing; Geriatic Nutrition – Factors affecting food

intake and nutrients use, Nutrient needs, Nutrition related problems

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- interpret the physiological and metabolic functions of nutrients.
- select appropriate carbohydrate diet based on their health effects.
- recommend the intake of lipids and proteins based on their nutritional value.
- assess energy balance and body composition.
- identify nutrition requirement based on different age groups.

TEXT BOOKS

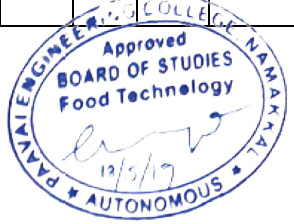
1. Mann Jim and Stewart Truswell, ―"Essentials of Human Nutrition", 3rd Edition,Oxford University Press, Oxford, 2007.
2. Michael J. Gibney, Susnadn A. Lanham-New, Aedin Cassidy and Hester H.Vorster,―"Introduction to Human Nutrition", 2nd Edition, Wiley Blackwell, UK, 2009.

REFERENCES

1. Gropper, Sareen S, and Jack L. Smith, ―"Advanced Nutrition and Human Metabolism", 5thEdition, Wadsworth Cengage Learning rd Publishing, US, 2008.
2. Srilakshmi B., ― "Nutrition Science", 3rd Edition, New Age International Publishers, New Delhi, 2011.
3. Shubangini A Joshi, ―"Nutrition and Dietetics", Tata Mc Graw Hill Pub. Co. Ltd., NewDelhi, 1998.
4. Mahan L.K. and Escott-Stump S., ―"Krause,,s Food, Nutrition and Diet Therapy", 10Edition,W.B. Saunders Company, London, 2000.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2
CO2	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	-	-	-	-	-	-		3	2	3
CO5	3	3	3	3	2	1	-	-	-	-	-	3	3	3



CM16305 FLUID FLOW PROCESS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- have a knowledge on fundamental concepts, fluid properties and fluid statics.
- impart the student knowledge on dynamic characteristics for through pipes and porous medium, flow measurement
- help the students to have knowledge on fluid properties characteristics while static, during flow through ducts, pipes and other channels.
- Knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I FLUID PROPERTIES AND STATICS 9

Physical properties of fluids – Classification of fluids – Pressure measurement – Manometers – Simple and Differential – Concept of buoyancy – Fluid statics and its applications. Dimensional homogeneity, Rayleigh and Buckingham-π method – Significance of different dimensionless numbers.

UNIT II FLOW OF COMPRESSIBLE AND INCOMPRESSIBLE FLUIDS 9

Types of fluid flow – Boundary layer concepts – Navier-Stokes' equation – Continuity Equation – Mass balance in a flowing fluid – Bernoulli's equation – Euler's equation of motion – Friction factor chart – Darcy weisbach Equation – Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits – Velocity profile and friction factor for smooth and rough pipes –Hagen-Poiseuille equation

UNIT III FLOW OF FLUIDS THROUGH SOLIDS 9

Form drag – Skin drag – Drag co-efficient – Flow around solids and packed beds – Friction factor for packed beds – Ergun's Equation – Motion of particles through fluids – Terminal settling velocity – Fluidization – Types – Advantages – Applications.

UNIT IV TRANSPORTATION 9

Measurement of fluid flow – construction, working and equation for variable head and variable area meters: Orifice meter – Venturimeter – Pitot tube – Rotameter – determination of discharge and discharge coefficient – Weirs and notches – Major and minor losses.

UNIT V METERING 9

Transportation of fluids – Performance curves and characteristics – Efficiency of Centrifugal pump, working principle of Positive displacement, Rotary and Reciprocating pumps – Introduction to Fans, blowers and Compressors.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the fundamental concepts of physical properties of fluids and its importance in fluid flow operations.
- treat problems in the movement of fluids through all kinds of process equipment and use dimensional analysis for scaling experimental results
- understand the fluid flow through packed and fluidized beds

- deal with the important engineering tasks of moving fluid through process equipment and of measuring and controlling fluids in flow.
- analyze pipe flows as well as fluid machineries used to transport the fluid and their performance

TEXT BOOKS

1. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Revised Ninth Edition, Laxmi Publications (p) limited, (2014).
2. A.P. Kulkarni, "Fluid Mechanics for Chemical Engineers" Nirali Prakshan Publication (2015).

REFERENCES

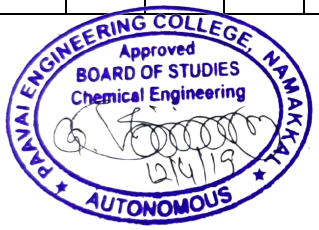
1. McCabe W.L, Smith, J C and Harriot. P "Unit operations in Chemical Engineering", McGraw Hill, VII Edition, (2005).
2. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, (1991).
3. White, Frank M. "Fluid mechanics, WCB." Ed McGraw-Hill Boston (1999).
4. Pletcher, Richard H., John C. Tannehill, and Dale Anderson. Computational fluid mechanics and heat transfer. CRC Press, 2012.

WEB LINKS

1. http:// www.nptel.ac.in
2. http:// www.msubbu.in
3. http://www.unitoperation.com

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
	Programme Outcome (POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	3	1	1	1	-	-	-	-	1	2	3
CO2	2	1	2	1	1	-	-	-	1	-	-	2	2	3
CO3	3	2	1	3	2	-	-	-	1	1	-	2	2	3
CO4	2	1	2	2	1	-	-	-	-	1	-	2	2	3
CO5	2	2	1	2	1	-	-	-	-	-	1	2	2	3



CH 16301 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

(COMMON TO CSE, EEE, CHEMICAL, FOOD & IT BRANCHES)

COURSE OBJECTIVES

To enable students to

- know the constituents of the environment and the precious resources in the environment.
- conserve all biological resources.
- understand the role of human being in maintaining a clean environment and useful environment for the future generations
- acquire knowledge about ecological balance and preserve bio-diversity.
- understand the role of government and non-government organizations in environment management.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Environment: Definition- scope - importance – need for public awareness. Forest resources: Use –over exploitation- deforestation - case studies- mining - effects on forests and tribal people. Water resources: Use – over utilization of surface and ground water- floods – drought - conflicts over water. Mineral resources-Use – exploitation - environmental effects of extracting and using mineral resources – case studies. Food resources: World food problems - changes caused by agriculture and overgrazing – effects of modern agriculture- fertilizer-pesticide problems - water logging - salinity -case studies. Energy resources-Growing energy needs - renewable and non renewable energy sources. Role of an individual in conservation of natural resources.

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concept of an ecosystem: Structure and function of an ecosystem – producers - consumers – decomposers– energy flow in the ecosystem – ecological succession – food chains - food webs and ecological pyramids. Types of ecosystem: Introduction - characteristic features - forest ecosystem – grassland ecosystem – desert ecosystem - aquatic ecosystems (lakes, rivers, oceans, estuaries). Biodiversity: Introduction– definition (genetic - species –ecosystem) diversity. Value of biodiversity: Consumptive use - productive use – social values – ethical values - aesthetic values. Biodiversity level: Global - national - local levels- India as a mega diversity nation- hotspots of biodiversity. Threats to biodiversity Habitat loss - poaching of wildlife – man wildlife conflicts – endangered and endemic species of India Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III POLLUTION 9

Pollution: Définition –air pollution - water pollution - soil pollution - marine pollution - noise pollution -thermal pollution – nuclear hazards. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - Disaster management: Floods – earthquake - cyclone- landslides. Electronic waste-Sources-Causes and its effects.

UNIT IV SOCIAL ISSUES AND ENVIRONMENT 9

Sustainable development: Unsustainable to sustainable development – urban problems related to energy. Water conservation - rain water harvesting - watershed management. Resettlement and rehabilitation of people. Environmental ethics: Issues - possible solutions – climate change - global

warming and its effects on flora and fauna - acid rain - ozone layer depletion - nuclear accidents - nuclear holocaust. Environment protection 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.

UNIT V HUMAN POPULATION AND ENVIRONMENT 9

Human population: Population growth - variation among nations – population explosion – family welfare programme and family planning – environment and human health– Human rights – value education – HIV/ AIDS Swine flu – women and child welfare. Role of information technology in environment and human health.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the relationship between the human population and environment.
- elaborate the basic concepts of environment studies and natural resources.
- gain the knowledge about ecosystem and biodiversity.
- Have knowledge about causes, effects and control measures of various types of pollution.
- Understand the social issues and various environmental acts.

TEXT BOOKS

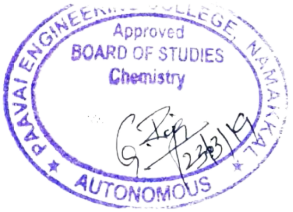
1. Raman Sivakumar, Introduction to Environmental Science and Engineering, 2nd Edn, Tata McGraw Hill Education Private Limited, New Delhi,(2010).
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, (2010).

REFERENCES

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India,2010 .
2. S. Divan, Environmental Law and Policy in India, Oxford University Press, New Delhi, 2001.
3. K.D. Wager, Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.
4. W.P. Cunningham, Environmental Encyclopedia, Jaico Publising House, Mumbai, 2004.

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
Programme Outcome (POs)														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	2	1	2	3
CO2	2	2	2	1	1	2	2	-	1	-	-	2	2	3
CO3	3	1	1	2	1	2	2	-	1	1	2	2	2	3
CO4	3	2	2	2	1	1	1	-	-	1	-	2	2	3
CO5	2	2	1	1	1	2	2	-	-	-	1	2	2	3



EE16307 ELECTRICAL MACHINE DRIVES AND SENSORS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- understand the Fundamentals of energy conversion, construction and principle of operation.
- perform characterization of electrical machines and various drives.
- realize the concept of starting methods and speed control of electrical machines.
- study the fundamentals of Sensors application.
- acquire knowledge on the operation of solid state speed control of D.C. and A.C. drives

UNIT I DC MACHINES 9

DC Generator - Construction and Principle of operation, EMF Equation, Types, OCC and External characteristics curves and Efficienc; DC Motors - Principle of operation, types, Characteristics of motor and Starters.

UNIT II AC MOTOR 9

Three phase Induction motors, Construction, Types, Principle of operation, Torque-slip characteristics and tarting methods, Single Phase Induction Motor-Construction and working principle of operation.

UNIT III FUNDAMENTALS OF ELECTRIC DRIVES

Basic Elements, Types of Electric Drives, Factors are influencing the choice of electrical drives, Heating and cooling curves, Loading conditions and classes of duty, Selection of power rating for drive motors, Load variation factors.

UNIT IV TRANSDUCERS AND SENSORS 9

Introduction to transducers, LVDT, Piezoelectric transducer, Temperature transducer, Pressure transducers; Introduction to sensors - Signal Conditioning of Sensors-Position Sensors, Inductive Position Sensors, Inductive Proximity Sensors, Rotary Encoders, Temperature Sensors, Light Sensors.

UNIT V SOLID STATE SPEED CONTROL OF D.C. AND A.C DRIVES USING CONVENTIONAL METHODS 9

Speed control of DC series and shunt motors, Armature and field control, Ward- Leonard control system - using controlled rectifiers (Single phase Half and Full wave), Speed control of three phase induction motor, Voltage control, voltage / frequency control, slip power recovery scheme; Inverters and AC voltage regulators, Applications

TOTAL PERIODS 45

COURSE OUTCOMES

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

- select and utilize several of dc machines.
- employ effective control techniques to electrical motors.
- understand concept applied in electric drives.
- select appropriate sensors for engineering applications.

- apply solid state speed control of DC and AC drives.

TEXT BOOKS:

1. Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2004.
2. VedamSubrahmaniam, "Electric Drives (concepts and applications)", Tata McGraw- Hill, 2001.
3. D. Patranabi, "Sensors and Transducers", PHI Learning Pvt. Ltd., 2006.

REFERENCES

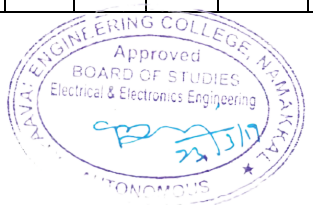
1. Theraja B.L and therajaA.K, „A Text book of Electrical Technology, volume – II, S,Chand &Co.,2007.
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 1998.
3. Ian.R.Sinclair, "Sensors and Transducers", BSP Publication, 2001.
4. Bimal K Bose, "Modern Power Electronics and AC Drives", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
5. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, Third Edition, 2004.

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	1	-	-	-	-	-	2	3	3
CO2	3	3	2	1	2	1	-	-	-	-	-	2	3	3
CO3	3	2	3	2	2	1	-	-	-	-	-	2	3	3
CO4	3	2	2	2	2	1	-	--	-	-	-	2	3	3
CO5	3	3	2	2	2	1	-	-	-	-	-	2	3	3



CM16306 FLUID MECHANICS LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable students to

- calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.
- calibrate and study the working of flow meters and
- find pressure loss for flowing fluid
- determine characteristics of different pump.

LIST OF EXPERIMENTS

1. Discharge coefficient of constant and variable head meters
2. Calibration of weirs and notches
3. Open drum orifice and draining time
4. Flow through straight pipe
5. Flow through annular pipe
6. Flow through helical coil and spiral coil
7. Losses in pipe fittings and valves
8. Characteristic curves of pumps (Centrifugal, Reciprocating)
9. Pressure drop studies in packed column
10. Pressure drop studies in Fluidized bed
11. Viscosity measurement
12. Calibration of Rotameter

TOTAL PERIODS 60

COURSE OUTCOMES

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

- understand the fundamental fluid flow properties and its measurements.
- apply the principles of dimensional analysis for Engineering applications.
- analyze the types of fluid flow in pipe
- analyze the performance of fluid moving machinery and appraise the types of valves and pipe fittings in process industries.

REFERENCES

1. McCabe, W.L, Smith J.C and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill, Fourth Edition, 1984.
2. J.M. Coulson and J.F. Richardson, "Chemical Engineering Vol - I &II", 6thEdition Butterworth –New Delhi, (2000).
3. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Revised Ninth Edition, Laxmi Publications(p) limited, (2014).
4. Noel De Nevers, "Fluid Mechanics for Chemical Engineers, "Second Edition, McGraw Hill (1991)

CO/PO MAPPING

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	2	-	3	-	-	1	2	3	-	2	2	3
CO2	2	3	-	-	-	-	2	-	1	-	-	-	2	3
CO3	2	-	2	-	-	-	-	2	-	2	-	-	1	2
CO4	-	-	1	-	-	-	2	-	-	-	-	2	3	3

FT16303 MICROBIOLOGY LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to,

- acquaint with various aspects of basic and applied microbiology.
- recognise and describe the characteristics of important pathogens and spoilage microorganisms in foods.
- utilize laboratory techniques to detect, quantify, identify and control microorganisms in food.
- know the basic practices in laboratory
- handle microganisms

LIST OF EXPERIMENTS / EXERCISES

1. Study experiment on lab equipment's and practices.
2. Identification of microorganisms by simple staining technique.
3. Identification of microorganisms by Gram's staining technique.
4. Observation of microorganisms by wet mount preparation and hanging drop technique.
5. Preparation of different culture media.
6. Techniques for isolation of microorganisms using serial dilution method.
7. Cultivation and enumeration of microorganisms using spread plate method.
8. Isolation of microorganisms by pour plate method.
9. Isolation of microorganisms by streak plate method.
10. Cultivation and enumeration of microorganisms in nature (air/soil/water).
11. Biochemical characteristics of microorganisms using IMVIC test.
12. Antibiotic sensitivity test for microorganisms.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- identify the morphology of microorganisms.
- prepare different types media to grow the microorganisms.
- cultivate, isolate and characterize the microorganisms.
- have a good laboratory practices.
- handle different plating techniques

REFERENCES

1. GunasekaranP. ―"Laboratory Manual in Microbiology", 1stEdition, New Age International Publications, New Delhi, 2005.

CO/PO MAPPING

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	1	-	-	-	-	-	3	3	2
CO2	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	-	-	-	-	-	-		3	2	3
CO5	3	3	3	3	2	1	-	-	-	-	-	3	3	3

EN16301 BUSINESS ENGLISH COURSE LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable students to

- develop the reading skills of the students and to familiarize them in skimming and scanning.
- instill the communication concepts and enhance the students' conversational skills through various practice sessions.
- familiarize them with a variety of business correspondence.
- develop the receptive skills such as listening and reading and to make the students well versed in the productive skills (writing & speaking).
- assist them in improving their vocabulary and comprehension of grammar.

UNIT I READING & VOCABULARY 8

Understanding short, notices, messages - detailed comprehension of factual material - skimming & scanning skills - interpreting visual information - reading for gist and specific information - reading for grammatical accuracy and understanding of text structure - reading and information transfer.

UNIT II ECOSYSTEMS AND BIODIVERSITY 7

Fixing appointments - asking for permission - giving instructions - apologizing and offering compensation - making or altering reservations - dealing with requests - giving information about a product.

UNIT III LISTENING 8

Listening to short telephonic conversation - Listening to short conversation or monologue - Listening to specific information - Listening to recorded interview, discussion.

UNIT IV SPEAKING 7

Conversation between the interlocutor and the candidate - general interaction and social language - A mini presentation by each candidate on a business theme - organizing a larger unit of discourse - giving information and expressing opinions - to way conversation between candidates followed by further prompting from the interlocutor- Expressing opinions - agreeing and disagreeing.

TOTAL PERIODS 30

List of Experiments

1. Reading
2. Writing
3. Listening
4. Speaking

COURSE OUTCOMES

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

- enrich the business vocabulary through reading.
- develop their pronunciation skills.
- speak effectively in English in various occasions
- prepare flawless reports and proposals.
- understand and communicate as a professional.

TEXT BOOKS

1. Cambridge BEC Preliminary, Self Study Edition, Cambridge University Press, New York, 2012.
2. Whitby, Norman. Business Benchmark, Pre-intermediate to intermediate, Business Preliminary, Shree Maitrey Printech Pvt. Ltd., Noida, 2014.

REFERENCES

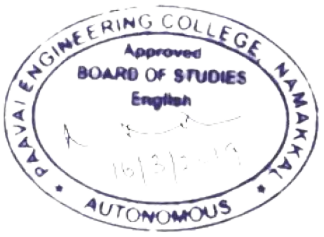
1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice Oxford University Press, New Delhi. 2011
2. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi.2005.
3. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi.

WEB SOURCE

1. http://www.cambridge.org/us/cambridgeenglish/catalog/cambridge-english-exams-ielts/business-benchmark

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
COs	**Programme Outcome (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	1	1	-	-	-	-	1	2	3
CO2	2	2	2	1	2	-	-	-	1	-	-	2	2	3
CO3	3	1	1	2	1	-	-	-	1	1	-	1	2	3
CO4	3	2	2	2	2	-	-	-	-	1	-	2	2	3
CO5	2	2	1	1	3	-	-	-	-	-	1	1	2	3



MA16403 PROBABILITY AND STATISTICS 3 2 0 4

COURSE OBJECTIVES

To enable students to

- acquire knowledge of the random variables and manipulate.
- analysis the relationship between the two random variables.
- determine the concepts of hypotheses testing, its need and applications.
- Students will be equipped with statistical techniques for designing experiments, analyzing, interpreting and presenting research data.
- provides the required skill to apply the statistical tools in engineering problems.

UNIT I RANDOM VARIABLES 15

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 15

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

UNIT III TESTING OF HYPOTHESIS 15

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

UNIT IV DESIGN OF EXPERIMENTS 15

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 15

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- have a fundamental knowledge of the concepts of probability.
- have knowledge of standard distributions which can describe real life phenomenon.
- have the notion of sampling distributions and statistical techniques used in engineering and management problems.
- design an experiment and conduct analysis of variance on experimental data, interpret the results and present them meaningfully.
- to critic on quality control with regard to statistical techniques used there in.

TEXT BOOKS

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

Edition, 2007

2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Papoulis. A and Unnikrishna Pillai. S., "Probability, Random Variables and Stochastic Processes" McGraw Hill Education India, 4th Edition, New Delhi, 2010.

REFERENCES

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

WEB LINKS

1. https://www.youtube.com/watch?v=IYdiKeQ9xEI
2. https://www.youtube.com/watch?v=J70dP_AECzQ
3. https://www.youtube.com/watch?v=pvvoK4rlzqQ
4. https://www.youtube.com/watch?v=IEP3swFeauE
5. https://www.youtube.com/watch?v=SAfS56Ez0QY

CO/PO MAPPING

Mapping of course outcomes with programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1- Weak														
COs	**Programme Outcome (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	2	1	1	-	-	-	-	1	2	3
CO2	2	2	2	1	2	-	-	-	1	-	-	2	2	3
CO3	3	2	1	2	2	-	-	-	1	2	-	1	2	3
CO4	3	2	2	2	2	-	-	-	-	1	-	2	2	3
CO5	2	3	2	1	3	-	-	-	-	-	1	1	2	3

FT16401 ANALYTICAL INSTRUMENTS IN FOOD INDUSTRIES 3 0 0 3

COURSE OBJECTIVES

To enable students to,

- give students a conceptual introduction to the various modern instrumental techniques in food analysis
- understand the applications, strengths and limitations of different methods
- provides them with an opportunity to identify different types of optical instruments
- understand the potential measurements using different methods
- understand the applications and limitations of chromatographic techniques

UNIT I SPECTROMETRY 9

Spectrometry - Classification of Instrumental methods, Electromagnetic radiation, Electromagnetic spectrum, Interaction of electromagnetic radiation with matter; Visible spectrometry and Colorimetry-Theory, Instrumentation (Line diagram alone) and applications; Ultra violet spectroscopy - Theory, Instrumentation, Single and Double beam, Applications; Infra-red spectroscopy - Theory, Fundamental Vibrations, Instrumentation, Applications.

UNIT II SPECTROSCOPY 9

Atomic Absorption and NMR Spectroscopy- AAS - Principle, Instrumentation and applications; NMRspectroscopy - Principle, Instrumentation, Chemical shift and applications; Thermal methods- Thermogravimetry, Differential thermal analysis, Differential Scanning Calorimetry - Principle, Instrumentation and applications.

UNIT III PHOTOMETER 9

X-Ray and Flame Photometer - X-ray diffraction, Principle, Instrumentation, Detectors and applications; Flame photometer - Theory, Instrumentation and applications; Polarimetry – Specific rotation, Optical activity, Principle and instrumentation. Saccharimetery - Analysis of Sugar.

UNIT IV CONDUCTANCE AND POTENTIAL MEASUREMENTS 9

Conductance and Potential Measurements - Definitions, Conductance Measurements, Applications, Types, Advantages and disadvantages of Conductometric titrations; Potential measurements, pH determination, Potentiometric Titrations; Basic principles of electrophoresis, Theory and application ofpaper and gel electrophoresis.

UNIT V CHROMATOGRAPHIC TECHNIQUES 9

Chromatographic Techniques - Introduction, Paper chromatography, Thin Layer Chromatography,Column Chromatography, Gas chromatography, HPLC – Reverse phase and normal phase - Principle,Instrumentation and applications.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- interpret the application of UV-Visible and IR spectroscopy in food analysis.
- make use of AAS, NMR and thermal methods to analyse different food materials.
- apply X- ray diffraction, flame photometers and Polarimetry in food analysis.
- recognize the usage of conductance and potential measurements for analysis of components.
- infer the chromatographic principles to separate and analyse materials.

TEXT BOOKS

1. Chatwal, Gurdeep R., and Anand, Sham K., ―Instrumentation Methods of Chemical Analysis, 2nd Edition, Himalaya Publications, Bombay, 2003.
2. Willard H.H, Merritt L.L, Dean J.A, and Settle F.A., ―Instrumental Methods of Analysis, 7th Edition, CBS Publishers and Distributors, New Delhi, 1988.

REFERENCES

1. Skoog Douglas A., West Donald M., Holler F James, and Crouch Stanley R.,―Analytical Chemistry: An Introduction, 7th Edition, South-Western, Australia, 2000.
2. Rouessac F., ―Chemical Analysis: Modern International Method and Techniques 3rdEdition, Wiley, New Delhi, 1999.
3. Banwell G.C., ―Fundamentals of Molecular Spectroscopy, 2nd Edition, Tata McGraw- Hill, New Delhi, 1992.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	2	1	-	-	-	-	2	2	2	2
CO2	2	1	3	-	2	1	-	-	-	-	1	2	2	2
CO3	2	2	2	1	2	1	-	-	-	-	1	2	3	2
CO4	2	2	2	1	2	1	-	--	-	-	1	2	2	
CO5	2	1	2	1	2	1	-	-	-	-	2	2	3	2

FT16402 FERMENTATION TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable students to,

- gain knowledge on various aspects of applied and industrial microbiology.
- understand fermenter design, different types of fermentations and also the current trend offermentation process in biotech-industry.
- know the production of different fermented foods, both industrial processes and traditionalfermented food products.
- know the role of the most important microorganisms (lactic acid bacteria, Bacillus, acetic acidbacteria, yeast, molds,) will be discussed.
- have knowledge on different fermentation techniques.

UNIT I FOOD FERMENTATION 9

Food Fermentation- Origin and history of food fermentation, Micro-organisms for fermentation, Starter Cultures and fermented Products, Manufacture of fermented products, Quality and flavour of fermented products.

UNIT II TYPES OF FERMENTATION 9

Types of Fermentation - Types of fermentation submerged/solid state; Sterilization-Air sterilization, Media sterilization; Batch/continuous fermentation, Scale up in fermentation; Maintenance of aseptic conditions.

UNIT III AERATION AND AGITATION IN FERMENTATION 9

Aeration and agitation in fermentation - Oxygen requirement, Measurement of adsorption coefficients, Bubble aeration, Mechanical agitation, Correlation between mass-transfer coefficient and operating variables.

UNIT IV FERMENTED PRODUCTS 9

Conductance and Potential Measurements - Definitions, Conductance Measurements, Applications, Types, Advantages and disadvantages of Conductometric titrations; Potential measurements, pH determination, Potentiometric Titrations; Basic principles of electrophoresis, Theory and application ofpaper and gel electrophoresis.

UNIT V PRODUCTION OF FERMENTED PRODUCTS 9

Production of Fermented products - Production of vitamins, Amino acids, Organic acids, Enzymes and antibiotics, Alcohols; Industrial production of beer, Wine; Enzymes - Amylase, Pectinase, Proteases, Vitamins, Antibiotics, Baker's yeast, Single cell protein; Fermented foods: Sauerkraut, Yoghurt, Cheese, Miso, Tempeh, Tofu, Idli, Dosa.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the principles of microbiology in the production of fermented foods.
- classify fermentation process and maintain aseptic conditions in a fermentation process.
- relate the process parameters in aeration and agitation of a fermentation operation.
- make use of concepts of fermentation in dairy, meat, cereal and beverage products.
- identify processes involved in production of various fermented products.

TEXT BOOKS

1. Y. H. Hui, Lisbeth Meunier-Goddik, JytteJosephsen, Wai-Kit Nip and Peggy S. Stanfield.,"Handbook of Food and Beverage Fermentation Technology", CRC Press, UK,2004.
2. Robert W. Hutkins., "Microbiology and Technology of Fermented Foods", CRC Press,UK,2004.

REFERENCES

1. Gutierre, Gustavo F., —"Food Science and Food Biotechnology", CRC Press, New York, 2003.
2. Crueger W. and Crueger A., —"Biotechnology: A Textbook of Industrial Microbiology",Science Tech. Madison, USA, 1984.
3. Stanbury P.F., and Whitake S.A., —"Principles of Fermentation Technology",Pergamon Press, Oxford, UK, 1984.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	3	3	-	-	-	-	-	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	2	-	-	-	-	3	2	2	-	-	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	3

FT16403 ENGINEERING PROPERTIES OF FOOD MATERIALS 3 0 0 3

COURSE OBJECTIVES

To enable students to,

- know about the structure and chemical composition of foods, Physical properties.
- gain knowledge on water activity, food stability sorption and desorption isotherm of foodmaterials.
- understand newtonian and non-newtonian fluid, Thermal properties and Electrical andmagnetic properties of food.
- aero- and hydrodynamic characteristics, application of frictional properties in grain handling,processing and conveying.
- understand textural properties and colour measurements of food materials

UNIT I PHYSICAL PROPERTIES OF FOOD MATERIALS 9

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.

UNIT II THERMAL PROPERTIES 9

Thermal properties - Definition of specific heat, Enthalpy, Conductivity and diffusivity, surface heattransfer coefficient; Measurement of specific heat, Thermal conductivity, Thermal diffusivity. Cryogenics, Calorific value of food, Bomb calorimeter, Applications of thermal properties.

UNIT III OPTICAL PROPERTIES 9

Refractive index of food items, Abbe‟s refractometer, Sorting of food material using optical properties Optical activity, Polarimeter, Spectrophotometer, Gloss, colour, translucency – Definitions, measurement and applications; Electromagnetic Properties - Electrical properties, Dielectric heating, Electrical conductivity, Dielectric measurements, Microwave heating and other applications.

UNIT IV RHEOLOGICAL PROPERTIES 9

Rheological Properties - Stress Strain behaviour of Newtonian and Non- Newtonian fluids, Bingham and Non Bingham; Stress-strain relationships in solids, liquids and viscoelastic behaviour, Stress relaxation test, Creep test and dynamic test, Stress-strain diagrams; Emulsions and Colloids; Viscosity – Principle, Types - Capillary, Orifice, Falling and Rotational viscometers.

UNIT V TEXTURAL PROPERTIES 9

Textural Properties - Types of food textures, Texture measuring instruments - Compression, Snap Bending, Cutting Shear, Puncture, Penetration and TPA; Properties of food powders; Colour- Interaction of object with light, Colorimeter - Color order systems- Munsel color system, CIE color system, Hunter lab color space, Loviebond system.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- interpret the physical properties of agricultural materials.
- elaborate the thermal properties and its application.
- outline the optical and electromagnetic properties.
- recognize the rheological properties of food materials.
- infer textural properties and color measurements of food materials

TEXT BOOKS

1. Rao M. A. and Rizvi S.S.H., ―Engineering Properties of Foods, Mercel Dekker Inc., NewYork, 1998.

2. Mohesnin N.N., ―Physical Properties of Plant and Animal Materials, Volume I,Gordon and Breach Science Publishers, New York, 1970.

REFERENCES

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", 3rd Edition, Gulf Publishing USA, 2001.

CO/PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	3	3	-	-	-	-	-	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	2	-	-	-	-	3	2	2	-	-	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	3

CM16405 CHEMICAL ENGINEERING THERMODYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- introduce fundamental thermodynamic principles and their application.
- learn the laws of thermodynamics.
- thermodynamic property relations and their application to fluid flow.
- get the knowledge about power generation and refrigeration processes.
- get the working knowledge of boilers.

UNIT – I BASIC CONCEPTS AND FIRST LAW 9

Fundamental concepts of thermodynamics - Microscopic and macroscopic approach, systems, Properties, Process, Functions, Units, Energy, Heat and work; Zeroth law; First law - statement of first law for flow and non - flow process, Internal energy, Enthalpy, Heat capacities (CV and CP) – Steady state flow processes with reference to various thermal equipment's - Nozzle, Throat, Throttling process

and compressors.

UNIT – II SECOND LAW 9

Second Law of thermodynamics - Kelvin-Plank, Clausius statements and its equivalence, Reversible cycle – Carnot cycle and theorem – Thermodynamic temperature scale. Entropy, Clausius theorem, Clausius inequality, Entropy changes during processes, Available and unavailable energies.

UNIT – III BEHAVIOR OF PURE FLUIDS 9

PVT surfaces - P-V, P-T, T-S and H-S Diagrams; Equation of state and the concept of ideal gas; Process involving ideal gases - Constant volume, Constant pressure, and constant temperature, Adiabatic and polytrophic process; Equation of state for real gases - Vander Waals equation, Redllich Kwong equation, Virial equation of state; Principle of corresponding states – generalized

Compressibility charts.

UNIT – IV STEAM PROPERTIES 9

Properties of steam, Usage of steam tables, Determination of dryness fraction of steam. Calorimeters – Tank or barrel type, Throttling, Separating, Separating and Throttling; Steam distribution systems, Typesof steam traps and their characteristics, Application of steam in food process industries.

UNIT –V BOILERS 9

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.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- outline the basic concepts and apply the first law of thermodynamics in selected processes.
- understand the principle of second law of thermodynamics and concepts of Carnot cycle.
- interpret the second law of thermodynamics and relate the properties of pure substance.
- estimate the properties of steam and measurement of quality of steam using calorimeters.
- integrate the use of simple calculation in gaining the working knowledge of different boilers.

TEXT BOOKS

1. Narayanan K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, New Delhi, 2003.
2. Kothandaraman C.P., Khajuria P.R., Arora S.C. and DomkundwarS.A., "Course in Thermodynamics and Heat Engines", 3rd Edition, Dhanpat Rai & Sons, New Delhi, 1990.

REFERENCE BOOKS

1. Ballaney P.L., "Thermal Engineering", 23rdEdition, Khanna Publishers, New Delhi, 2005.
2. Smith J.M., Van Ness H.C, and Abbott M.M., "Introduction to Chemical Engineering Thermodynamics", 7th Edition, McGraw Hill, New York, 2005.
3. Rao Y.V.C., "An Introduction to Thermodynamics", Universities Press, 2004.

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	3	2	1	3	-	-	1	-	-	3	2
CO2	-	2	2	2	1	1	3	-	-	1	2	-	2	3
CO3	2	2	2	1	-	-	-	-	-	1	2	-	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	2	-	-	2	2	-	3	2

CM16406 PROCESS HEAT AND MASS TRANSFER 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- understand the principles and applications of heat transfer operations.
- heat exchanges and mass transfer operations in food processing industry.
- illustrate the theories related to absorption and various distillation methods.
- identify the principle of extraction and leaching in mass transfer operation.
- design heat and mass transfer equipments.

UNIT -I HEAT TRANSFER–CONDUCTION 9

Basic transfer processes - Heat, Mass and momentum; Heat transfer process; Conductors and insulators – conduction; Fourier's fundamental equation; Thermal conductivity and thermal resistance; Linear heat flow; Heat transfer through homogenous wall, Composite walls, Radial heat flow through cylinders and sphere; Extended surfaces (fins); Solving problems in heat transfer by conduction.

UNIT- II HEAT TRANSFER-CONVECTION 9

Newton Rikhman's law – film coefficient of heat transfer; Convection – Free and forced convection dimensional analysis and its application; Factors affecting the heat transfer coefficient in free and forced convection heat transfer; Overall heat transfer coefficient; Solving problems in heat transfer by convection.

UNIT -III HEAT TRANSFER –HEATEXCHANGER 9

Heat exchangers - Parallel, Counter and cross flow; Evaporator and condensers; Logarithmic Mean Temperature Difference; Overall coefficient of heat transfer; Tube in tube heat exchanger, Shell and tube heat exchanger, Plate heat exchanger; Applications of heat exchangers; Solving problems in heat exchangers.

UNIT-IV HEAT TRANSFER: RADIATION 9

Radiation heat transfer – Concept of black and grey body; Monochromatic total emissive power ; Kirchof's law – Planck's law - Stefan-Boltzman law; Heat exchange through non-absorbing media; Solving problems in heat transfer by radiation.

UNIT-V MASSTRANSFER :DIFFUSION 9

Mass transfer - Introduction – Fick's law for molecular diffusion, Molecular diffusion in gases, Equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B; Diffusion through a varying cross sectional area and diffusion coefficients for gases, Molecular diffusion in liquids, Biological solutions and gels.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand and apply the principles in heat transfer phenomena
- understand and apply the principles in mass transfer phenomena
- design heat and mass transfer equipments
- gain knowledge about heat exchangers
- identify the basics of diffusion mass transfer and its application in food processing

TEXT BOOKS

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

REFERENCES

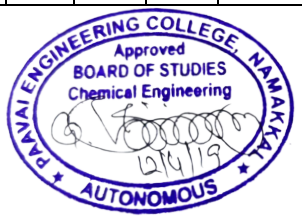
1. Jacob and Hawkins. "Elements of Heat Transfer", John Willey and Sons Inc. New York, 1983.
2. EcKert, E.R.G. "Heat and Mass Transfer". McGraw Hill Book Co., New York, 1981.
3. Holman, E.P. "Heat Transfer". McGraw-Hill Publishing Co. New Delhi, 2001.
4. Coulson, J.M. and etal. "Coulson & Richardsons Chemical Engineering", 6th Edition, Vol. I &II, Butterworth – Heinman (an imprint of Elsevier), 2004.
5. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, McGraw Hill, 2003.

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's)

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes (PO's)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	3	2	1	3	-	-	1	-	-	3	2
CO2	-	2	2	2	1	1	3	-	-	1	2	-	2	3
CO3	2	2	2	1	-	-	-	-	-	1	2	-	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	2	-	-	2	2	-	3	2



FT16404 INSTRUMENTAL METHODS OF ANALYSIS LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to,

- identify different types of analytical instruments in their respective laboratories.
- gain knowledge about various chemical treatments in analysis.
- know the methods used in nutrient analysis.
- evaluate the result of analysis and identify the compounds present in it.
- calibrate the instruments

LIST OF EXPERIMENTS

1. Precision and validity in an experiment using absorption spectroscopy.
2. Validating Lambert-Beer's law using KMnO4.
3. Chromatography analysis using TLC.
4. Chromatography analysis using column chromatography.
5. Estimation of BOD.
6. Estimation of COD.
7. Gas chromatography analysis.
8. Estimating color of food using spectrophotometer.
9. Use of electrophoresis in determination of protein.
10. Use of flame photometer in estimation of trace metals like sodium and potassium.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- take professional sampling and sample treatment prior to analysis.
- calibration of Instrumental methods and troubleshoot.
- understand and capable of performing basic chemical processes in an analytical laboratory.
- perform measurements on basic analytical instruments (photometers, spectrometers chromatographs, ion-selective electrodes).
- Practice the good laboratory practices

TEXT BOOKS

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

REFERENCES

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

CO/PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**														
CO's	**Programme Outcomes (PO's)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	3	2	1	3	-	-	1	-	-	3	2
CO2	-	2	2	2	1	1	3	-	-	1	2	-	2	3
CO3	2	2	2	1	-	-	-	-	-	1	2	-	2	3
CO4	2	-	2	-	2	-	3	-	-	2	2	-	3	2
CO5	1	2	2	3	2	-	2	-	-	2	2	-	3	2

FT16405 FOOD FERMENTATION LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to,

- understanding concepts, principles and procedures involved in the area of fermented food production.
- familiarizing with different fermenter types and their design criteria.
- to understand conditions that influence growth and fermentation
- the students should be able to understand explicitly the concepts, develop their skills in the preparation, identification and quantification of microorganisms.

LIST OF EXPERIMENTS

a) Study of fermenter, designs and types.

b) Inoculation of culture.

c) Production, recovery and control tests for the following fermentation products.

1. Baker‟s yeast
2. Amylases
3. Pectinase
4. Yoghurt/ kefir
5. Wine
6. Cheese
7. Dahi
8. Sauerkraut

TOTAL PERIODS 60

COURSE OUTCOMES

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

- demonstrate the types of sterilization techniques ,cultivation and plating techniques of microorganism.
- interpret the different types of staining techniques and biochemical analysis of bacteria.
- illustrate the biochemical analysis of microorganisms and microbial growth kinetics.
- examine the load of coliform bacteria ,antimicrobial activity and production of alcoholic beverage.
- illustrate the effect of pH , temperature and UV on microbial growth.

TEXT BOOKS

1. Joshi, V. K. “Biotechnology: Food Fermentation” Volume 1. Educational Publishers & Distributors, 2004.

2. Hui Y. H et al. “Handbook of Food and Beverage Fermentation Technology”. Marcel Dekker, 2004.
3. Wood, Brian J. B. “Microbiology of Fermented Foods” Volume 1 & 2. 2nd Edition. Blackie Academic & Professional, 1998.

REFERENCES

1. Farnworth, Edward R. “Handbook of Fermented Functional Foods” 2nd Edition. CRC Press, 2008.
2. Godfrey, T. and West, S. (1996). ”Industrial enzymology”, stock Holon Press, New York.
3. Pederson, C.S. (1979). ”Microbiology of food fermentation” AVI Publ., Westport, CT.
4. Pandey, A. (1994). ”Solid state fermentation”, New Age, Publc. New Delhi.

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CO’s	Programme Outcomes (PO’s)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	-	-	-	3	3	-	-	-	-	-	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	2	-	-	-	-	3	2	2	-	-	-	-	2	2

CM16407 HEAT AND MASS TRANSFER LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to,

- enable the student to basic study of the phenomena of heat and mass transfer, to develop methodologies for solving food engineering problems.
- understand the information concerning the performance and design of Heat exchangers.
- develop processes with better heat efficiency and economics.
- provide knowledge on various flows measuring equipment's involved in food industries.
- Develop knowledge in handling equipments

LIST OF EXPERIMENTS

1. Pressure drop across Fluidized bed columns.
2. Heat transfer studies of a shell and tube heat exchanger.
3. Separation factors of the experiments with liquid – liquid extraction.
4. Separation factors of the experiments with solid –liquid extraction.
5. Separation factors of the experiments with ion exchange.
6. Drying characteristics of Tray dryer
7. Drying characteristics of Rotary dryer
8. Water purification using ion exchange columns
9. Separation of binary mixture using Simple distillation
10. Separation of binary mixture using Steam distillation

TOTAL HOURS 60

COURSE OUTCOMES

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

- the basic laws of heat transfer and account for the consequence of heat transfer in thermal analyses of engineering systems.
- understand the importance of fluid flow in industrial applications.
- describe the use of flow measuring devices and demonstrate the loss of energy due to friction in pipes.
- calculate the losses of energy due to fittings in pipe flow systems.
- have a good laboratory practices

TEXT BOOKS

1. McCabe, W.L, Smith J.C and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill, Fourth Edition, 1984.
2. Geankoplis, Christie J. "Mass transport phenomena". Holt, Rinehart and Winston, 1972.

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CO1	3	1	-	-	-	3	3	-	-	-	-	-	3	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	2	-	-	-	-	3	2	2	-	-	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	3