Teaching Scheme and Syllabi of B.E. (Food Technology) [2020-2021]

First Year

1st SEMESTER

S. No.	Course code	Courses	Contact hrs per week			Total contact hours	Mid Term	End Term	Total Marks	Credits
			L	T	P					
1.	BS101	Mathematics –I	3	1	-	60	50	50	100	4
2.	BS105	Chemistry (Organic)	3	-	-	45	35	40	75	3
3.	ESC-GES103	Electrical & Electronics Engineering	3	1	-	60	50	50	100	4
4.	PCC-CS101	Material & Energy Balance	3	1	-	60	50	50	100	4
5.	ESC-GES104	Computer Programming for problem solving	2	-	-	30	25	25	50	2
6.	ESC-GES153	Electrical & Electronics Engineering Lab.	-	-	3	45	40	0	40	1.5
7.	BS155	Chemistry (Organic) Lab.	-	-	3	45	40	0	40	1.5
8.	ESC-GES154	Computer Lab.	-	-	2	30	25	0	25	1
		Total	**14**	**3**	**8**	**375**	**315**	**215**	**530**	**21**

Note:

- NSS/NCC/Sports proficiency/Community services/Professional society activities/Technical activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid -term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance (10% of Mid-term marks)
2. End -Term

2nd SEMESTER

S. No.	Course code	Courses	Contact hrs per week			Total contact hours	Mid Term	End Term	Total Marks	Credits
			L	T	P					
1.	BS102	Physics	3	1	-	60	50	50	100	4
2.	BS103	Chemistry (Inorganic)	3	-	-	45	35	40	75	3
3.	BS104	Mathematics –II	3	1	-	60	50	50	100	4
4.	HSMC-HASS 101	Communication Skills	1	-	-	15	10	15	25	1
5.	ESC-GES 151	Engineering Graphics	-	-	3	45	40	-	40	1.5
6.	ESC-GES 152	Engineering Workshop	-	-	3	45	40	-	40	1.5
7.	BS152	Physics Lab.	-	-	2	30	25	-	25	1
8.	BS153	Chemistry (Inorganic) Lab.	-	-	3	45	40	-	40	1.5
9.	HSMC-HASS 151	Communication Skills Lab.	-	-	2	30	25	-	25	1
		Total	**10**	**2**	**13**	**375**	**315**	**155**	**470**	**18.5**

Note:

- NSS/NCC/Sports proficiency/Community services/Professional society activities/Technical activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid -term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance (10% of Mid-term marks)
2. End -Term

SCHEME OF TEACHING AND EXAMINATION

SEMESTER-3rd										
S. No.	**Course code**	**Subjects**	**Teaching Hrs. per Week**			**Total contact hours**	**Mid Term**	**End Term**	**Total Marks**	**Credit**
			L	**T**	**P**					
1	FT 101	Element of Bio & Food Science	3	-	-	45	35	40	75	3
2	PCC-CS102	Fluid Flow	3	1	-	60	50	50	100	4
3	FT 102	Biochemistry & Nutrition	3		-	45	35	40	75	3
4.	PCC-CS-105	Chemical Engineering Thermodynamics	3	1	-	60	50	50	100	4
5	PCC-CS106	Mechanical Operations	3	1	-	60	50	50	100	4
6	FT 151	Element of Bio & Food Science Lab	-	-	2	30	25		25	1
7	FT 152	Biochemistry & Nutrition Lab	-	-	2	30	25		25	1
8	PCC-CS152	Fluid Flow Lab	-	-	3	45	40		40	1.5
9	PCC-CS155	Mechanical Operations Lab	-	-	3	45	40		40	1.5
		Total	**15**	**3**	**10**	**420**	**350**	**230**	**580**	**23**

Note:

- NSS/NCC/Sports proficiency/Community services/Professional society activities/Technical activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. Mid-Term
   a. One best of two minor tests (50% of Mid -term marks)
   b. Assignments (20% of Mid-term marks)
   c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
   d. Attendance (10% of Mid-term marks)
2. End -Term

SCHEME OF TEACHING AND EXAMINATION

SEMESTER-4th										
Sl. No.	**Course code**	**Subjects**	**Teaching Hrs. per Week**			**Total Contact hour**	**Mid Term**	**End Term**	**Total Marks**	**Credit**
			L	**T**	**P**					
1	PCC-CS 104	Heat Transfer	3	1	-	60	50	50	100	4
2	FT103	Food Chemistry	3	-	-	45	35	40	75	3
3	FT 104	Food Microbiology	3	-	-	45	35	40	75	3
4	FT 105	Processing of Cereals & Pulses	3	1	-	60	50	50	100	4
5	ESC-GES 105	Strength of Materials	3	-	-	45	35	40	75	3
6	ESC-GES-157	Process Equipment Design	-	-	3	45	40	-	40	1.5
7	PCC-CS 154	Heat Transfer Lab	-	-	3	45	40		40	1.5
8	FT 155	Processing of cereal and Pulses Lab	-	-	2	30	25		25	1
9	FT 153	Food Chemistry Lab	-	-	2	30	25		25	1
10	FT 154	Food Microbiology Lab	-	-	3	45	40		40	1.5
		Total	**15**	**2**	**13**	**450**	375	**220**	**595**	23.5

Note:

- NSS/NCC/Sports proficiency/Community services/Professional society activities/Technical activities related to the field of Engineering (1st to 3rd year, 2 credits to be earned in 7th semester)
- Discipline (1st to 4th year, 1 credit to be earned in 8th semester)

L: Lectures/Week, T: Tutorials/Week, P: Practical Hours/Week

Assessment will consist of the following components

1. Mid-Term
    a. One best of two minor tests (50% of Mid -term marks)
    b. Assignments (20% of Mid-term marks)
    c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)
    d. Attendance (10% of Mid-term marks)
2. End -Term

Fifth Semester

S No.	Course code	Subject	L	T	P	Credits	Practical	Mid term	End term	Total marks	Category
1	CHE 204	Heat Transfer	3	1	3	5	25	50	50	125	CHE
2	CHE 304	Mass Transfer -I	3	1	-	4	-	50	50	100	CHE
3	FT 301	Processing of Cereals & Pulses	3	1	2	5	25	50	50	125	FT
4	FT 302	Processing of Fruits and Vegetables	3	-	2	4	25	35	40	100	FT
5	FT 303	Beverage Technology	3	-	-	3	-	35	40	75	FT
6	FT 304	Confectionery Technology	3	-	-	3	-	35	40	75	FT
7	FT 305	Beverage & Confectionary Technology	-	-	2	1	25	-	-	25	FT
8	CHE 306	Process Plant Design-I	-	-	3	1	25	-	-	25	CHE
		Total	**18**	**3**	**12**	**26**	**125**	**255**	**270**	**650**	
		Total contact hours/week	**33**								

Note:

- **Sports proficiency/Community services/ Professional society activities/ Technical activities related to the field of Engineering (1st to 3rd year---2 credits to be earned in 7th semester)**
- **Discipline (1st to 4th year, 1 credit to be earned in 8th semester)**

Sixth Semester

S No.	Course code	Subject	L	T	P	Credits	Practical	Mid term	End term	Total marks	Category
1	CHE 301	Numerical Methods in Chemical Engineering	3	1	-	4	-	50	50	100	CHE
2	CHE 309	Mass Transfer-II	3	1	3	5	25	50	50	125	CHE
3	CHE 303	Chemical Reaction Engineering-I	3	1	3	5	25	50	50	125	CHE
4	FT 306	Processing of Oil Seeds, Oils and Fats	3	-	2	4	25	35	40	100	FT
5	FT 307	Processing of Milk and Milk products	3	-	2	4	25	35	40	100	FT
6	CHE307	Chemical Engineering Computation Lab	-	-	3	1	25	-	-	25	CHE
7	CHE 405	Process Plant Design-II Lab	-	-	3	1	25	-	-	25	CHE
		Total	**15**	**3**	**16**	**24**	**150**	**220**	**230**	**600**	
		Total Contact hours/week	**34**								

Note:

- **Sports proficiency/Community services/ Professional society activities/ Technical activities related to the field of Engineering (1st to 3rd year---2 credits to be earned in 7th semester)**
- **Discipline (1st to 4th year, 1 credit to be earned in 8th semester)**

Seventh Semester

S. No.	Course code	Subject	L	T	P	Credits	Practical	Mid term	End term	Total marks	Category
1	CHE 310	Process Dynamics and Control	3	1	3	5	25	50	50	125	CHE
2	FTO401	Open Elective- I	3	-	-	3	-	35	40	75	FTO
3	CHE 408	Process Engineering Economics	3	1	-	4	-	50	50	100	CHE
4	FTD 401	Departmental Elective- I	3	-	2	4	25	35	40	100	FTD
5	FT 401	Project Work	-	-	2	-	-	-	-	-	FT
6	FT 402	Literature Survey, Report Writing and Seminar	-	-	3	NC	-	-	-	-	FT
7	FT 403	Industrial Training	-	-	-	1	-	25	-	25	FT
		Total	**12**	**2**	**10**	**17**	**50**	**195**	**180**	**425**	
		Total Contact hours/week	**24**								

Note:

- **Sports proficiency/Community services/ Professional society activities/ Technical activities related to the field of Engineering (1st to 3rd year---2 credits to be earned in 7th semester)**
- **Discipline (1st to 4th year, 1 credit to be earned in 8th semester)**

SEMESTER-8th											
S.No.	**Course code**	**Subject**	**L**	**T**	**P**	**C**	**Practical**	**Mid Term**	**End Term**	**Total Marks**	**Category**
1	CHE 402	Environmental Engineering	3	1	3	5	25	50	50	125	CHE
2	FTD 402	Department Elective- II	3	1	-	4	-	50	50	100	FTD
3	FTO 402	Open Elective-II	3	-	2	4	25	35	40	100	FTO
4	FTO 403	Open Elective-III	3	-	-	3	-	35	40	75	FTO
5	FTD 403	Departmental Elective- III	3	1	-	4	-	50	50	100	FTD
6	FT 401	Project work	-	-	2	2	-	-	'S' or 'X' *	-	FT
7	CHE 403	Process Modelling and Simulation Lab	-	-	3	1	25	-	-	25	FT
8	FT 404	Comprehensive Viva	-	-	-	1	-	-	25	25	FT
		Total	**15**	**3**	**10**	**24**	**75**	**220**	**255**	**550**	
		Total Contact hours/week	**28**								

***'S' (Satisfactory) or 'X' (Repeat)**

Note:

- **Discipline (1st to 4th year, 1 credit to be earned in 8th semester)**

List of Departmental Electives

A) Meat Fish & Poultry Technology
B) Packaging Technology
C) Biochemical Engineering
D) Food Biotechnology
E) Functional Food
F) Industrial Safety and Hazards
G) Plant Utilities

List of Open Electives

A) Process Instrumentation
B) Food Regulation & Quality Control
C) Food Rheology and Texture
D) Nano Technology
E) Supply Chain and Logistics Management
F) Operations Research
G) Project Management & Entrepreneurship

Program Educational Objectives (PEOs)

Food Technology

1. The graduates of four year Food technology program will work as food engineers, process engineers, production engineers and design engineers in food process and allied industries.
2. The graduates will pursue higher studies in various institutions in India and Abroad and also find opportunities in R&D organizations in areas of process design and development of food engineering products and thus strive for lifelong learning.
3. The graduates possess effective communication skills and abilities to work and lead in multidisciplinary teams, possess professional attitude and ethics.

PROGRAM OUTCOMES (PO'S)

1. The graduates have ability to apply knowledge of physical (basic) sciences, mathematics and food technology. **(Engineering Knowledge)**

2. Ability to identify, formulate and solve food process engineering problems. **(Problem Analysis)**

3. Capability to conduct experiments for new product development and design commercial equipments and analyze, interpret and present data. **(Design & Development of Solutions)**

4. Use research methods, design of experiments and analysis techniques to analyze, interpret and present data and to solve complex engineering problems and provide valid conclusions. (**Investigation of Complex Problem**)
5. Use the IT techniques, modeling and simulation skills, and modern engineering tools necessary for Food Technology. (**Modern Tools Usage**)
6. Analyze the local and global impact of engineering solutions and applications on individuals, organizations and impact on society as well as the impact of society on professional Food Technologists. (**Engineer and Society**).
7. Design a system, a component, or a process to solve the problems within realistic constraints such as economic, social, environmental, ethical, health and safety, manufacturability and sustainability. (**Environment & Sustainability**)
8. Understand the importance of professional ethics. (**Ethics**)

9. Function effectively individually or as a member of a team with the objective of performing and achieving goals. (**Individual & Team work**).
10. Communicate and present themselves effectively. (**Communication**)
11. Recognize the need for, and to engage in continuous professional development. (**LifelongLearning**)
12. Understand the principles of engineering and management and apply these to the discipline as a member or leader in a team, to manage projects. (**Project management & Finance**).

BACHELOR OF ENGINEERING (FOOD TECHNOLOGY) (2020-2021)

FIRST YEAR

1st SEMESTER

Title	**MATHEMATICS-I**			**Credits**	04
Code	BS101	**Semester:-**1st		**L T P**	3 1 -
Max.Marks	**End term- 50**	**Mid term- 50**		**Elective**	N
Pre requisites				**Contact Hours**	60
Course Objectives	To make the students 1. Understand the behavior of infinite series and their use. 2. Learn the concepts related to functions of several variables and their applications. 3. Understand the concept of Vectors and its applications. 4. Learn the methods of evaluating multiple integrals and their applications to various problems. 5. Learn the methods to formulate and solve linear differential equations and apply them to solve engineering problems.				
Course Outcomes	CO 1: To test the behavior of infinite series. Operate vectors and convert line integral to surface integral to volume integral. CO 2: Analyze functions of several variables and their applications. CO 3: Evaluate multiple integrals and apply them to practical problems. CO 4: To study cylinders and cones and understand applying cylindrical and polar coordinates. Formulate and solve linear differential equations.				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.				
SECTION- A					
Infinite Series: Infinite series and convergence, alternating series, power series and convergence. Taylor's and Maclaurin's Series.					
Multivariable Functions: Limit, Continuity and Partial Derivatives; Euler's Theorem for Homogeneous functions; Differentiability, Linearization and Differentials; Chain rule; Extreme values and Saddle Points; Lagrange multipliers; Taylor's Formula.					
Vector Deferential Calculus and Integral Theorems: Gradient, Divergence, Curl, Statement of Green's, Gauss and Stoke's Theorem and their simple applications.					
SECTION- B					
Solid Geometry: Cylinders and Cones, Cylindrical and Spherical Polar Coordinates					
Integral Calculus: Area between plane curves; Volumes of solids of revolution; Lengths of plane curves; Areas of surfaces of revolution. Double integrals in rectangular and Polar form, Triple integrals in Rectangular, Cylindrical and Spherical coordinates, Substitutions in Multiple Integrals.					
Ordinary Differential Equations: First order exact differential equations, Integrating factor, Orthogonal trajectories, Second and Higher order Linear Differential Equations with constant coefficients, Differential Operators, Methods of					

Variation of Parameters and Undetermined Coefficients, Euler Cauchy Equation, Wronskian.	
Text books:	1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Ninth Edition, Pearson Education. 2. E. Kreyszig: Advanced Engineering Mathematics, Eighth Edition, John Wiley.
Reference Books:	1. B. V. Ramana: Higher Engineering Mathematics, Tata McGraw Hill. 2. B. S. Grewal: Higher Engineering Mathematics, 41st Edition, Khanna Publishers, Delhi. 3. Differential Equations, Frank Ayers, TMH
Course Assessment Methods	Assessment will consist of the following components 3. Mid-Term 1. One best of two minor tests (50% of Mid -term marks) 2. Assignments (20% of Mid-term marks) 3. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks) 4. Attendance. (10% of Mid-term marks) 4. End -Term

Title	**CHEMISTRY (ORGANIC)**			**Credits**	3
Code	BS105	**Semester:- 1st**		**L T P**	3 - -
Max marks	**End term- 40**	**Mid term- 35**		**Elective**	N
Pre-requisites				**Contact hours**	45

Course objectives

1. Learn and understand the concept of structural conformations and stereochrmistry of organic compounds
2. To introduce the basic knowledge regarding acidity, basicity and nucleophilicity of organic compounds
3. To explain the formation of different reaction intermediates like free radical , carbonium and carbanion ion in order to be able to understand the mechanism of various substitution reactions.
4. To create an awareness about the effect of different attached groups on the reativity and rate of reaction in organic synthesis.

Course outcomes

CO1: Understand and explain the different nature and behaviour of organic compounds
CO2: Understand the concept of stereochemistry
CO3: Learn and identify organic reaction intermediate and explain the mechanism including the free radical substitution , electrophilic addition, electrophilic aromatic substitution and nucleophilic reactions.
CO4: Identify important organic reactions and their application for syntheses.

SECTION A

Reactivity of organic molecules: Shapes and Molecular orbital structures of compounds containing C, N and O. Conformations of cyclic and acyclic systems, structures of dienes, pyridine, pyrrole, aromatic compounds. Factors affecting acidity,basicity and nucleophilicity of molecules (Kinetic as well as thermodynamic aspects) 08 hrs

Delocalisation: Concept of aromaticity, stability of cycloalkanes, resonance concept, inductive and mesomeric effects, directive effects, activating and deactivating groups. 06 hrs

Stereochemistry : Enantiomers, Diastereomers, Meso-and Racemic compounds, Resolution of racemic mixture. Asymmetric synthesis, Walden Inversion, Configuration (D and L nomenclature), Absolute con figuration (R , S, E and Z nomenclature) 08hrs

SECTION B

Organic Reagents and Reaction Intermediates : free radicals, carbonium and carbanions and the mechanism of important substitution,elimination as well as important rearrangenet reactions-- : House synthesis, halogenation of alkanes, free radical mechanism, orientation, reactivity and selectivity ;catalytic hydrogenation, dehydration of alcohols, dehydrohalogenation, Saytzeff rule, electrophillic addition reactions, peroxide effect, mechanism of allylic substitution, acidity of 1-alkynes, conjugated dienes, 1,2-and 1,4- additions, free radical and ionic mechanisms of addition polymerisation reactions, ringopening reactions of cyclopropane and cyclobutane, chemistry of benzene and alkylbenzenes, aromatic electrophillic substitution reactions, nucleophilic substitution Friedel-Crafts reactions, Anisole nucleophilic addition, Aldol condensation 18 hrs

Synthetic utility of diazonium salts, synthetic utility of Grignard reagents and alkyllithiumsk, basicity of amines, multistep synthesis. 05hrs

Books Recommended:

1. Bahl, B. S. & Bahl, Arun : Text-book of Organic Chemistry, 16th Edition, S. Chand and Company Ltd., New Delhi.
2. Solomons, T. W. G. : Fundamentals of Organic Chemistry, John Wiley and Sons, Inc., New York, 1994.
3. Morrison & Boyd : Organic Chemistry, Pearson education, 6th edition, 2007.
4. F.A.Carey: Organic Chemistry, Tata McGraw Hill, 7th edition, 2008.
5. Mukherji & Singh: Reaction mechanism in organic chemistry, Macmillan India Ltd.,

Title	**ELECTRICAL AND ELECTRONICS ENGINEERING**		**Credits**	4
Code	ESC-GES103	**Semester:- 1st**	**L T P**	3 1 -
Max. marks	**End term- 50**	**Mid term- 50**	**Elective**	N
Pre-requisites			**Contact hours**	60
Objectives	• To provide students about basic knowledge of A.C and D.C circuits, theorems, laws. • Introduce to the students about difference between single phase and three phase system. • To teach the students basic principle of operation of transformers and other electrical machines. • To make them aware of the difference between analog and digital system and study diodes, rectifiers, digital circuits.			
Note for examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.			

SECTION A

DC Circuits and Single Phase A.C. Fundamentals

General introduction to Electrical Engineering, Kirchoff's Laws ,Mesh and Node analysis, Superposition theorem , Thevenin Theorem, Norton Theorem, Maximum power transfer theorem. Generation of alternating voltages and currents, Equations for AC quantities, cycle, time period, frequency, amplitude, calculation of R.M.S values, Average values for different waveforms, solution and phasor diagram of single phase AC circuit with sinusoidal source of excitation, series and parallel combination of R-L-C circuits.

Three Phase AC Fundamentals Disadvantages of single phase system, star and delta connection in three phase circuits, relation between line and phasor quantities, power in three phase system, solution of three phase balanced circuits, power and power factor measurement by two wattmeter method.
Electrical Machines **B**asic principle and construction of transformers, E.M.F equation, approximate equivalent circuit, phasor diagram, losses, efficiency and condition for maximum efficiency, open circuit and short circuit test on single phase transformers. Operating principle and construction of three phase induction motors, Operating principle and construction of DC Machines, types of DC Machine & E.M.F equations
SECTION B
Semiconductor Diodes and Transistors General introduction to Electronics.Concept of stiff Voltage and Current Source. PN Junction, Depletion layer, Barrier Potential, Forward and Reverse Bias, Breakdown voltage, V-I characteristics, Half wave and full wave rectifiers, Zener diode. Introduction to junction transistors, Transistor amplifying action, CB, CE, CC-configuration characteristics.
Digital Electronics Binary and Hexadecimal number system, conversion of numbers from one system to other, OR, Relations: Commutative, Associative and Distributive Laws. Concept of flip-flops, RS,JK flip flops, shift register.

Text Books	1. Edward Hughes: Electrical and Electronic Technology, Pearson Education Publication, Asia, 2003. 2. Nagsarkar, T.K. and Sukhija M.S.: Basic Electrical Engg., Oxford University Press, 2004. 3. Bhargava: Basic electronics and Linear circuits, Tata McGraw Hill.
Reference Books	1. Nagrath, I.J. and Kothari, D.P.: Basic Electrical Engg., TMH, New Delhi. 2. Malvino: Digital Principles and Applications, Tata McGraw Hill
Course Assessment Methods	Assessment will consist of the following components 1.Mid-Term a. One best of two minor tests (50% of Mid -term marks) b. Assignments (20% of Mid-term marks) c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks) d. Attendance. (10% of Mid-term marks) 2.End –Term
Course Outcomes	CO1: The student will understand how various loads are connected in circuits and difference between single and three phase system. CO2: The students will know the principles and working of different types of electrical machines used in industry CO3: The students will have the basic knowledge of digitalization and conversion of physical quantity to digital quantity.

Title	**MATERIAL AND ENERGY BALANCE**		**Credits**	04
Code	PCC-CS101	**Semester:-**2nd	**L T P**	3 1 -
Max.Marks	**End term- 50**	**Mid term- 50**	**Elective**	N
Pre requisites			**Contact Hours**	60
Course Outcomes	CO1: To review of Stoichiometric and composition relationship gas law, conversions etc. CO2: To study the dimensional consistency of the equations and review of basic concepts of fluid flow, vapour pressure and gaseous mixture. CO3: To study and application of material and energy balance of non-reacting and reacting systems for recycle, by pass and purge streams. CO4: To study combustion calculation s and use steam tables and psychometric charts.			
Note for	The semester question paper of the subject will be of 50 marks having 8 questions of			

examiner	equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.

SECTION-A

Review: Stoichiometric and composition relationship gas laws; Gaseous mixtures, vapor pressure, humidity, etc.

Material Balances for Non-reaction systems including balances involving recycle and by-pass streams.

SECTION-B

Material Balances for Reacting systems including balances involving recycle and purge streams.

Combustion Calculations.

Energy balances on nonreactive and reactive systems.

***Books Recommended*:**

1. Bhatt, V. I. & Vora, S. M. : Stiochiometry, 3rd Edition, Tata McGraw Hill, 1984.
2. Himmelbleau, D. M. : Basic Principles and Calculations in Chemical Engineering, 6th Edition, Prentice Hall, 1977.
3. Felder, R. M. & Rousseau R.W. : Elementary Principles of Chemical Processes, 3rd Edition, John Wiley and Sons, 1986.
4. Reklaithis, G. V. : Introduction of Material and Energy balances, John Wiley, 1983.
5. Lubyben, L.W. & Winzel, L. A. : Chemical Process Analysis, 2nd Edition, Prentice Hall, 1988.

Title	**COMPUTER PROGRAMMING FOR PROBLEM SOLVING**		**Credits**	2
Code	ESC-GES 104	**Semester:-**1st	**L T P**	2 -
Max. Marks	**End term-** 25	**Mid term-** 25	**Elective**	N
Pre requisites			**Contact Hours**	30
Objectives	1. To develop logical skills so that students should be able to solve basic computing problems. 2. To learn the syntax and usage of C++ programming constructs.			
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.			

SECTION- A	**Hrs**
Introduction To Programming: Basic introduction to computers, block diagram of computer.Evolution of languages: Machine languages, Assembly languages, High-level languages. Software requirements for programming: System softwares like operating system, compiler, linker, loader. Application programs like editor. Overview of Algorithm and Flowcharts.	04
Programming In C++ : Data types in C++, Formatted input-output for printing integer, floating point numbers, characters and strings.	04
Operators And Expression: Expressions in C++ and their evaluation. Precedence and associativity rules. Operators:	04

arithmetic operators, relational operators, logical operators,miscellaneous operators.	
Statements: Decision making structures: if, if-else, nested if and if-else, switch-Case. Loop control structures: for, while, do-while. Role of statements like break, continue, go to.	03
SECTION- B	
Arrays: Concept and use of arrays, declaration and usage of 1-dimensional arrays and 2-dimensional arrays.	04
Functions: Advantage of modularizing C++ program into functions, function definition and function invocation. Methods of passing parameters to a function: call-by-value, call-by-reference; Passing arrays to functions, Recursion, Library functions.	04
Introduction To User-Defined Data Types: Structures- definition, declaration, use. Unions: definition, declaration, use, introduction to classes and Properties of object oriented programming **.**	04
Introduction to Numerical Methods And Spreadsheet Calculations: Developing programs to solve engineering computation problems and working with spreadsheets.	03

Text books:	1. Arora, Sumita"Computer Science with C++" Dhanpat Rai & Co. 2. Balaguruswamy, "Object Oriented Programming in C++", Tata McGraw Hill.
Reference Books:	1. Kamthane, "Object Oriented Programming in ANSI and Turbo C++" Pearson Education India 2. Lafore ,Robert "Object Orients Programming in C++"
Course Assessment Methods	Assessment will consist of the following components 1.Mid-Term a. One best of two minor tests (50% of Mid -term marks) b. Assignments (20% of Mid-term marks) c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks) d. Attendance. (10% of Mid-term marks) 2.End –Term
Course Outcomes	CO1: The student will demonstrate proficiency in C++ programming language. CO2: The student will be able to solve basic engineering computation problems using C++

Title	**ELECTRICAL AND ELECTRONICS ENGINEERING LAB.**		**Credits**	1.5
Code	ESC-GES 153	**Semester:-**1st	**L T P**	- - 3
Max. Marks	**Practical- 40**		**Elective**	N
Pre requisites			**Contact Hours**	45

Objectives	Students will be able • to design electric circuits. • To use voltmeter ,ammeter and wattmeter • Perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit • To identify diode characteristics and transistor characteristics and perform experiments related to rectifiers(half-wave and full-wave) • To verify various logical gates and networking theorems through experiments.

1. Overview of the equipments, instruments and procedure to be used, safety precautions and report writing.

2. To study resonance in R-L-C series and parallel circuit.	
3. Measurement of power and power factor by three voltmeter method.	
4. Measurement of power and power factor by three ammeter method.	
5. To measure power and power factor using a single wattmeter in a single phase circuit.	
6. Measurement of power and power factor of three phase balanced load by two wattmeter method.	
7. To perform open circuit test and short circuit test on a single phase transformer and draw equivalent circuit.	
8. To obtain magnetization characteristics of DC Machine	
9. Study the forward and reverse biased diode characteristics.	
10. Study the CB, CE, CC transistor characteristics.	
11. To obtain the waveforms of half wave rectifier circuit on CRO.	
12. To obtain the waveforms of full wave rectifier circuit on CRO.	
13. Verification of basic and universal gates.	
14. To verify the thevenin theorem, nortan theorem, Maximum power transfer theorem	
Course Outcomes	CO1: Students will have hands on knowledge about the design, purpose and working of R-L-C series and parallel circuits CO2: Students will become confident in taking accurate readings of voltmeter, ammeter and wattmeter CO3: Students will have in depth knowledge about transformers, transistors, diodes and rectifiers and will be able to understand their applications in industry. CO4: Students will have knowledge about networking theorems and their utility in industry.

Title	**CHEMISTRY (ORGANIC) LAB.**		**Credits**	1.5
Code	BS155	**Semester:-** 1st	**L T P**	- - 3
Max. Marks	**Practical- 40**		**Elective**	N
Pre requisites			**Contact Hours**	45

1. Synthesis of organic compounds :Preparation of Benzamide & Aspirin-Purification, determination of melting point and percentage yield.
2. Identification of unknown organic compounds through group detection, physical constants and preparation of derivatives – Hydrocarbons, Phenols, Aldehydes, Ketones, Carboxylic acids, Amides and Amines.

Course objectives

1. : To familiarise with the laboratory equipments, various chemicals and set up a chemical reaction to ensure lab safety.
2. To Learn and apply basic technique used in the organic laboratory for preparation, purification of organic compounds.
3. To understand the synthesis of Benzamide & Aspirin and carry out the purification and percentage yield of compounds
4. To Identify important functional groups by the study of their properties and chemical reactions.

Course Outcomes

CO1: Practise analytical skills and recognize various aspects of lab safety.
CO2: Learn and apply basic technique used in the organic laboratory for preparation ,purification, and identification of oganic compound.
CO3: Outline the synthesis of Benzamide and Asprin, and carry out the purification and percentage yield of compound.
CO4: Identify important functional groups by a study of their properties and reaction.

Title	COMPUTER LAB.		Credits	1
Code	ESC-GES 154	Semester:-1st	L T P	- - 2
Max. Marks	Practical- 25		Elective	N
Pre requisites			Contact Hours	30

Objectives	1. To develop programs using C++ 2. To make the students design programs by using logic and become confident in handling numerical problems .
1. Programs based on input & output in C++	
2. Programs using Decision Statements if-else, CASE	
3. Programs using while statements, do- while and for Loops	
4. Array based programs	
5. Developing user defined Functions with and without recursion	
6. How to create and access user defined data types	
7. Implementation of engineering computation programs using MATLAB and EXCEL spreadsheet.	
Course Assessment Methods	The students will be assessed based upon the practical assignments and viva voce
Course Outcomes	CO1: The students will be able to demonstrate proficiency in C++ CO2: The student will become confident in solving any computation problem using his programming skills.

2nd SEMESTER

Title	PHYSICS			Credits	04
Code	BS102	Semester:-2nd		L T P	3 1 -
Max.Marks	End term- 50	Mid term- 50		Elective	N
Pre requisites				Contact Hours	60
Objectives	Basic concepts of optics and its applications, electromagnetism and magnetism properties, and Structural characterizations.				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.				

SECTION A

1. Optics and Fibre Optics (12L + 4T)

- Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications.

- Polarisation: Introduction, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.

- Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres.

- Lasers: Introduction to interaction of radiation with matter, principles and working of laser: population inversion, pumping, various modes, threshold population inversion, types of laser: solid state, semiconductor, gas; application of lasers.

2. Structural Characterization: (16 hours+5T)

Crystal Lattice, points groups, Bravais lattices, crystal systems, X ray diffraction Symmetry X-ray generation, Bragg Law, factors influencing intensity, Techniques, Indexing, precise lattice parameter determination, residual stress measurement

SECTION B

3. Electromagnetism and Magnetic Properties of Materials (17L + 6T)

Dielectric Materials: Review of basic formulas, dielectric constant and polarizability, sources of polarizability, classical treatment of dipolar, ionic and electronic polarizability, piezoelectricity, ferroelectrcity. (4)

Magnetic Materials: Review of basic formulas, magnetic susceptibility, classification of materials, Langevin diamagnetism, paramagnetism (only classical treatment), magnetism in metals, ferromagnetism in insulators, anti-ferromagnetism and ferrimagnetism, ferromagnetism in metals, ferromagnetic domains, hysteresis (8)

Superconductivity: Zero resistance, occurrence of superconductivity, Meissner effect, critical field, thermodynamics of superconducting transitions, electrodynamics of superconductors, qualitative idea of BCS theory. (3)

Nanotechnology: Nanomaterials and its applications, chemical and physical synthesis techniques of nano-powder and thin films. (2)

Text Books	1. Introduction to Solid State Physics: Charles Kittle 8th Ed.
Reference	a. Material science and Engineering – An Introduction by William D

Books	Callister, Jr, Sixth Edition, John Wiley and Sons. b. Material science and Engineering – A First Course by V.Raghvan Fourth Edition, EasternEconomy Edition c. Introduction to Solids (Tata McGraw Hill, Third Edition) - Leonid V Azaroff
Course Assessment Methods	Assessment will consist of the following components 1.Mid-Term a. One best of two minor tests (50% of Mid -term marks) b. Assignments (20% of Mid-term marks) c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks) d. Attendance. (10% of Mid-term marks) 2.End –Term

Course outcomes

CO1: Understand Bragg's law and introduced to the principles of lasers, types of lasers and applications.
CO2: Various terms related to properties of materials such as permeability, polarization etc.
CO3: Basic knowledge of structural properties, crystal structure and X ray diffraction analysis.
CO4: Basic knowledge of magnetic, superconducting, dielectric properties of materials.
CO5: Knowledge of nanomaterials, nanotechnology and its application.

Title	**CHEMISTRY (INORGANIC)**		**Credits**	03
Code	BS103	**Semester:-**2nd	**L T P**	3 - -
Max.Marks	**End term- 40**	**Mid term- 35**	**Elective**	N
Pre requisites			**Contact Hours**	45
Objectives				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.			

Section A

Introduction to quantum theory for chemical systems : Quantum theory and atomic structure: Introduction to wave mechanics, the Schrodinger equation, as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals from the Schroedinger equation . 06 hrs

Chemical Bonding and structure Part I : Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules. Bonding in Coordination Compounds: Theories of bonding i.e , Werner's theory, effective atomic number, valence bond theory, crystal field theory, crystal fields plitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Kinetic and Thermodynamic aspects of coordination compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series).Electronic spectra and magnetic properties of complexes.. 10 hrs

Homogeneous catalysis/mechanism of industrially important reactions :Organometallic Compounds: Nomenclature, types of ligands and bonding in organometallic compounds, The catalytic properties of the organometallic compounds and the mechanism of homogeneous catalysis for important industrial processes like hydrogenation, polymerisation and hydroformylation etc. 06 hrs

SECTION B

Chemical Bonding and structure Part II: Ligand Substitution reactions in complexes with coordination numbers 4 and 6 and their mechanism . Kinetic aspects of substitution in coordination compounds; Magnetic behaviour of complexes – Para magnetism, diamagnetism, ferromagnetism and antiferromagnetism and measurement of magnetic susceptibility of complexes by Guoy's method.

09 hrs

Inorganic polymers: Types of inorganic polymers, polyphosphazenes, polysiloxanes –their structures and properties. 05 hrs

Bio-inorganic Chemistry of Iron and cobalt – Heme proteins, Non-Heme iron proteins, Iron Sulphur proteins and coenzyme B_{12} ; 05 hrs

Metal Toxicology : Toxic effects of heavy metals with special reference to Cd, Pb, Hg and As. 04hrs

Recommended Books:

1. Sharpe, A. G. : Inorganic Chemistry, 3rd Edition, Longman Publishers ELBS, 1992.
2. Lee, J. D. : Concise: Inorganic Chemistry, 5th Edition, Chapman and Hall Publishers, 1996.
3. Cotton, F. A. & Wilkinson, G. : Advanced Inorganic Chemistry, 3rd Edition,Wiley Eastern Ltd., 1982.
4. Cotton, F. A. & Wilkinson, G. : Basic Inorganic Chemistry, Wiley EasternLtd., 1987. 12
5. Mark, J., West, R. & Allcock,H. : Inorganic Polymer, Prentice Hall, New Jersey Publishers, 1982.
6. Basola, F. & Pearson, R. G. : Inorganic Reaction Mechanism, 2nd Edition, Wiley Eastern Publishers, 1984.
7. Amdur, Doull & Klaasen (Eds.) : Casarett and Doulls Toxicology, Pergamon Press, New York, 1991.
8. William & Burson (Eds.) : Industrial Toxicology: Safety and Health applications in the work place, Van Nostrand – Reinhold, New York, 1985.
9. *Inorganic Chemistry*: Principles Of Structure And Reactivity, 4e By James E. Huheey , Ellen A. Keiter , Richard L. Keiter

Course Assessment Methods	Assessment will consist of the following components 1.Mid-Term a. One best of two minor tests (50% of Mid -term marks) b. Assignments (20% of Mid-term marks) c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks) d. Attendance. (10% of Mid-term marks) 2.End –Term
Course Outcomes	CO1: Understanding the basics of wave mechanics and chemical bonding in inorganic chemistry. CO2: Understanding the relation between structure and reactions of various complex compounds. CO3: Understanding the mechanism of various reaction and the ways to control them. CO4: Identifying the elements hazardous to nature and means to control them.

Title	**MATHEMATICS-II**			**Credits**	4
Code	BS104	**Semester:- 2nd**		**L T P**	3 1 -
Max marks	**End term- 50**	**Mid term- 50**		**Elective**	N
Pre-requisites				**Contact hours**	60
Course Objectives	The students shall 1. Learn to expand various functions in terms of Fourier series. 2. Learn the methods to formulate and solve partial differential equations. 3. Be taught to apply the method of separation of variables to solve partial differential equations of engineering interest. 4. Learn to find Laplace transforms and inverse transforms and apply these to solve differential equations. 5. Understand the concept of Complex functions and their applications to various problems.				

Course Outcomes	CO 1: Expand functions in terms of Fourier series and introduction of harmonic analysis. CO 2: Formulate and solve various partial differential equations. Solve partial differential equations of engineering interest by the method of separation of variables. CO 3: Find Laplace transforms, inverse transforms and apply these to solve various differential equations. CO 4: Evaluate complex integrals and apply these to various problems.
Note for examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.

SECTION A

Fourier Series

Euler's Formulae, Dirchielet's Conditions for Expansion, Change of interval, Odd and Even Functions, Expansion of Odd and Even Periodic Functions, Introduction to Harmonic Analysis.

Partial Differential Equations (Pde's)

Formation and classification of partial differential equations, first order linear equations, standard forms of non linear equations, Charpit's method, homogeneous linear equations with constant coefficients.

Engineering Applications Of Pde's

Method of separation of variables , Solution of partial differential equations of engineering interest by the method of separation of variables.

SECTION B

Laplace Transforms

Definition, Transforms of Elementary functions, Properties of Transforms, Inverse Transforms, Transforms of Derivatives, Unit Step Function, Dirac's Delta Function & Unit Impulse function. Periodic Functions, Application of Transform to the solution of ordinary Differential equations

Calculus Of Complex Functions

Functions of complex variables, analytic functions, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formula, introduction to Tayler's series and Laurent's series, Residues, Residue theorem and its simple applications.

Text Books	1. G. B. Thomas, R. L. Finney: Calculus and Analytic Geometry, Ninth Edition, Pearson Education. 2. E. Kreyszig: Advanced Engineering Mathematics, Eighth Edition, John Wiley.
Reference Books	1. B. V. Ramana: Higher Engineering Mathematics, Tata McGraw Hill. 2. B. S. Grewal: Higher Engineering Mathematics, 41st Edition, Khanna Publishers, Delhi. 3. Differential Equations, Frank Ayers, TMH
Course Assessment Methods	Assessment will consist of the following components 1.Mid-Term e. One best of two minor tests (50% of Mid -term marks) f. Assignments (20% of Mid-term marks) g. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks) h. Attendance. (10% of Mid-term marks) 2.End –Term

Title	**COMMUNICATION SKILLS**		**Credits**	1
Code	HSMC-HASS 101	**Semester:- 2nd**	**L T P**	1 - -

Max. marks	End term- 15	Mid term- 10		Elective	N
Pre-requisites				Contact hours	15
Objectives	1. To inculcate effective communication skills in students for better performance in professional as well as personal life 2. To improve personality of students with advanced techniques in verbal, non verbal and para verbal communication.				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section. The duration of End Term exam will be 3 hrs.				

SECTION A

Advanced Communication Skills

Scope, Significance, Process of Communication in an Organization, Types and Levels, Communication Networks, Technical Communication, Tools of Effective Communication, Barriers of Communication.

Speaking Skills

Interpersonal Communication, Presentation Skills, Voice Modulation, Persuasion, Negotiation and Linguistic Programming, Public Speaking, Group Discussions, Interviews and Case Studies, Conducting Meetings and Conferences

Personality Development

Body Language and importance of Non Verbal communication, Social and Professional etiquettes.

SECTION B

Communication and Media

Social and Political Context of Communication, Recent Developments in Media

Advanced Techniques in Speaking Skills

Importance of Listening/Responding to native and global accents, Telephonic Interviews and Video Conferencing

Advanced Techniques in Technical Writing

Job Application, CV Writing, Business Letters, Memos, Minutes, Reports and Report Writing Strategies, E-mail Etiquette, Blog Writing, Instruction Manuals and Technical Proposals

Text Books	1. Ashraf, M. Rizvi, "Effective Technical Communication", McGraw Hill 2. Bovee, Courtland L. and John, V. Thill, "Business Communication Today", Pearson Education
Reference Books	1. Sharma, R.C. and Mohan, K., "Business Correspondence and Report Writing", Tata McGraw Hill 2. Raman, Minakshi and Sharma, S., "Technical Communication: Principles and Practice", Oxford University Press 3. Scott, Bill, "Communication for Professional Engineers", Thomas Teleford Ltd. 4. McMurrey, David A. and Joanne, Buckley, "Handbook for Technical Writing", Cengage Learning 5. Harve, L., Locke, W. and Morey, A., "Enhancing Employability and Recognizing Diversity", Universities UK and CSU 6. Lock, R., "Student Activities for taking charge of your Career Direction and Job Search", Cole Publishing Pease, A., "Body Language", Sheldon Press
Course Assessment Methods	Assessment will consist of the following components 1.Mid-Term a. One best of two minor tests (50% of Mid -term marks) b. Assignments (20% of Mid-term marks) c. Class Surprise Tests/ Quizzes/Presentations/Term paper (20% of Mid-term marks)

	d. Attendance. (10% of Mid-term marks) 2.End –Term
Course Outcomes	CO1: Gain proficiency in English language as medium for communication in both professional and personal life CO2: Increase in employment prospective of students by developing technical aspects of communication. CO3: Personality development of students by thorough knowledge of effective and enhanced communication skills

Title	**ENGINEERING GRAPHICS (PRACTICAL)**		**Credits**	1.5
Code	ESC-GES 151	**Semester:-**2nd	**L T P**	- - 3
Max. Marks	**Practical-** 40		**Elective**	N
Pre requisites			**Contact Hours**	45

PRACTICAL	
Objectives	Objectives of the Engineering Drawing course is 1. To introduce the students to visual science in the form of technical graphics. 2. To give general instructions related to Theory of Orthographic Projection of points, lines, planes and solids as per the BIS codes prevalent to drawing practices. 3. To upgrade the basic understanding and visualization of geometric objects and machine parts by introducing the students to section of solids, intersection and development of surfaces, isometric projection and orthographic projection of simple solids/blocks. 4. To introduce the students to Computer graphics to enhance understanding of the subject.
1. Introduction to engineering drawing, instruments, symbols and conventions in drawing practice.	
2. Types of lines and BIS codes for lines, dimensioning	
3. Introduction to methods of projections: Orthographic projection, Isometric projection	
4. Projection of points, lines, planes and solids on principal and auxiliary planes.	
5. Sectioning of solids, Intersection of solids	
6. Development of surfaces	
7. Drawing of threaded fasteners and assembly drawing	
8. Introduction to CAD software.	
Recommended Books:	1. P.S. Gill: Engineering Drawing 2. R.K. Dhawan : A textbook of engineering Drawing, S. Chand & Co. Ltd. New Delhi 2nd edition. 3. P.S.Gill: Machine Drawing 4. Sham Tickoo : Understanding AutoCAD 2006, Wiley Publication 5. James D. Bethune : AutoCAD, Pearson Publishers
Course Assessment Methods	The students will be assessed based upon the practical assignments and viva voce.
Course Outcomes	CO1: Understand the use of different drawing tools, types of lines, dimensioning rotation of planes and types of projections. CO2: Projection of points, lines and planes. Visualization of solid objects through projection of solids and assembly drawing. CO3: Understand the importance of development of surfaces, isometric projection and computer graphics.

Title	**ENGINEERING WORKSHOP (PRACTICAL)**		**Credits**	1.5
Code	ESC-GES 152	**Semester:- 2nd**	**L T P**	- - 3
Max. marks	**Practical –** 40		**Elective**	N
Pre-			**Contact**	45

requisites		**hours**	

PRACTICAL	
Objectives	• To make the students understand the need and importance of different manufacturing techniques. • To introduce the different tools and equipments used in mechanical workshops and develop the skill to use the same.
Carpentry Shop: Description and use of carpenter's tools, Wood and timber, defects found in wood, seasoning of wood. Different types of timber in common use, making of lap joint, Bridle joint, dovetail joint and Mitre joint.	
Electric Tools: Exercise of wiring in link clip and casting and causing wiring of lights with switches in parallels, series and with 2 ways switches, Connecting energy meter, main switch and distribution board, testing a wiring installation for insulation resistance, Relevant Indian Electricity Rules.	
Machine Shop: Classification of fabrication processes, machine tools and materials, introduction to working of lathe, shapper, milling and drilling machines, power hacksaw, shearing machine and grinding wheel. Simple turning, threading, drilling board and knurling operations on a lathe.	
***Welding*:** Introduction to electric arc welding, gas welding and their use in making different types of joints e.g. lap joint, butt joint and T joint.	
Reccomended Books	1. Raghuwanshi, B.S. : A course in Workshop technology, Vol 1 & II, Dhanpat Rai & Sons , New Delhi. 2. Swarn Singh: Workshop Technology.
Course Outcomes	CO1: Identify basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail join, Bridle joint, and Mitre joint. CO2: Recognize and differentiate between the use of arc welding and gas welding in making different types of welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint. CO3: Describe the various fabrication processes in Machine shop, use of machine tools and materials, introduction to working of lathe, shapper, milling and drilling machines, power hacksaw, shearing machine and grinding wheel. CO4: Recognize the wiring techniques in link clip and casting and causing wiring of lights with switches in parallels, series and with 2 ways switches, Connecting energy meter, main switch and distribution board, testing a wiring installation for insulation resistance.

Title	**PHYSICS LAB**		**Credits**	1
Code	BS152	**Semester:- 2nd**	**L T P**	- - 2
Max. marks	**Practical –** 25		**Elective**	N
Pre-requisites			**Contact hours**	30

Objectives

Physics lab provides students the firsthand experience of verifying various theoretical concepts learnt in theory courses.

In a semester at least 10 experiments to illustrate the concepts learnt in Physics (Number of lab. Hrs. 2 per experiment)

1. To find the energy band gap of the given semiconductor by four probe method.
2. To study the Hall Effect of a given semiconductor
3. To determine the dielectric constant of the given materials.
4. To study the B-H curve of the ferromagnetic materials.
5. To determine the value of e/m for electron by long solenoid (helical) method.
6. To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph
7. To determine the velocity of ultrasonics waves in a given liquid.
8. To determine the frequency of A.C. mains using a sonometer and an electro-magnet.
9. To find the capacitance of a capacitor using flashing and quenching of a neon lamp.

10. To plot graph between current and frequency in a series LCR circuit and to find the resonant frequency.
11. To find the wavelength of sodium light using Fresnel's biprism.(3)
12. (i) To determine the wavelength of He-Ne laser using transmission grating.
    (ii) To determine the slit width using the diffraction pattern.
13. To determine the wave length of sodium light by Newton's rings method.
14. To determine the wave length of sodium light using a diffraction grating.
15. To find the specific rotation of sugar solution using a Bi-quartz Polarimeter.
16. To design a hollow prism and used it find the refractive index of a given liquid
17. To synthesize the nanoparticles by chemical methods and structural characterization through X-ray diffraction.
18. To investigate the optical band gap of nanomaterial using UV-vis spectroscopy.
19. Fabrication of thin films by spray pyrolysis technique.
20. Fabrication of thin films using spin coater technique.

Text Books	1. Practical Physics by CL Arora, S Chand & Co. 2. Engineering physics by S.K. Srivastva
Reference Books	A text book of practical physics by William & Watson
Course Assessment Methods	One *project out of 6 carries 40% marks, 20% for respective viva and 20% for external exams and 10% for attendance.
Course outcomes	CO1: Proficiency in technical aspects of performing the experiments. CO2: State various laws which they have studied through experiments. CO3: Experimental data observations and analysis. CO4 Proficiency in designing scientific projects and reporting

Title	**CHEMISTRY (INORGANIC) LAB.**		**Credits**	1.5
Code	BS153	**Semester:- 2nd**	**L T P**	- - 3
Max. marks	**Practical –** 40		**Elective**	N
Pre-requisites			**Contact hours**	45

Practical session wise break-up

No. of sessions

I. Volumetric Analysis :

(i) Redox Titrations :-Titrations involving

a) KMnO4 (Estimation of C2O4 -2) 02

b) $K_2Cr_2O_7$ (Estimation of Fe+2/Fe+3) 02

c) Iodine [Iodometry & Iodimetry] (Standardisation with Sodium Thiosulphate,Estimation of Cu+2, AsO3 -3 and Sb+3) 04

(ii) Complexometric Titrations- Determination of Zn+2 by EDTA titration. 02

II Gravimetric Analysis

a) Estimation of Ba+2/SO4 -2 as BaSO4

b) Estimation of Fe+2/Fe+3 as Fe2O3 04

Text Book: Vogel's Qualitative Inorganic Analysis, 7th Ed. By G. Svehla, Pearson Education.

Course Outcomes

CO1: getting hands on training in handling various equipment.
CO2: understanding practically all theoretical concepts
CO3: working with discipline and as a team with co-operation.

Title	**COMMUNICATION SKILLS LAB.**		**Credits**	1
Code	**HSMC-HASS 151**	**Semester:- 2nd**	**L T P**	- - 2
Max. marks	**Practical –** 25		**Elective**	N
Pre-			**Contact**	30

requisites		**hours**	
Objectives	1.To develop better pronunciation and communication skills. 2.To be able to face interviews and participate in conferences or any personal or professionals discussions with confidence. 3.To develop technical writing skills. 4.To be able to articulate ones voice and overcome stage fright.		
Organizational Communication Verbal and Non-Verbal Communication at different levels of organization, Role Play, Interaction with Bosses and Co-employees			
Speaking Techniques Preparation of Interviews, Participation in Group Discussions and Case Studies, Making and Presenting Power Point Lectures.			
Advanced Speaking Techniques Conducting Meetings and Conferences, Exposure to different Accents, Listening and responding in the global scenario, Telephonic Interviews/Conversations, Video Conferencing			
Technical Writing Writing Letters, Memos, Minutes, Notes, CV, Job Applications, Reports and e-mails, Preparing Instruction Manuals and Technical Proposals			
Course outcomes	CO1: English Speaking skills of students will be enhanced. CO2: Students will become self confident in handling both professional and personal meetings/discussions. CO3: Students will be able to demonstrate improved technical writing skills. CO4: Overall personality of students as well as their communication skills will be developed.		

THIRD SEMESTER

SECOND YEAR

3rd SEMESTER

Title	Element of Bio & Food Science			**Credits**	3
Code	FT 101	**Semester:-**3rd		**L T P**	3 - -
Max.Marks	**End term- 40**	**Mid term- 35**	**Practical --**	**Elective**	N
Pre requisites				**Contact Hours**	45
THEORY				**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
Course Objectives	1. *Developing an awareness about interactions of biology with food technology.* 2. *Acquaint students to concepts of biology and various techniques of microbiology.* 3. *Introducing students to various methods involved in processing and preservation of food.*				
Course Outcomes	CO1 Understand the basic principles of cells and the metabolic processes of cells in terms of cellular organelles, membranes, and biological molecules. Along with that various methods used for the isolation, identification and maintenance of microbial cultures. CO2 Understand the molecular basis of genetic information and the flow of genetic information from DNA to RNA to protein and the concept of mutations. CO3 Knowledge of various food regulatory bodies in food processing and packaging as well as differentiating between different materials used in food packaging like metals, glass, plastics and papers and their methods of production. CO4 Understanding techniques employed by food industries to preserve the raw material and finished products and to increase its shelf life by tackling various physical, chemical and biological constraints				

SECTION- A

Introduction to Biology and its branches. Prokaroytic and Eukaryotic cells. Cells: Animal and Plant cell structures, organelles and their functions. Cell division and cell cycle. Histology : Plant and Animal tissues, Muscles in animals. Photosynthesis of Plants. Digestion of foods in animals. Organisms and their environments – Ecosystems. Growth and development in plants and animals. Relevance of Microbiology in preservation of foods. Composition of microbial world. Branches of Microbiology. Microscopes and their application in Microbiology. Morphology and physiology of virus, bacteria, yeast, molds and algae. Growth, nutrition and reproduction. Isolation and identification of microorganisms. Pure cultures and their characteristics. Sterilization. Maintenance of cultures. Culturing techniques: Batch culturing, Continuous culturing, Fed-batch culturing. Factors affecting growth. Generation of energy and its uses in biosynthesis. General principles of bacterial genetics, DNA as genetic material, Mutations and their Chemical basis, recombinant DNA technology. Strain improvement by mutations, recombinant DNA technology - Application of recombinant DNA technology, recombinant products available in the market, in pipeline and at laboratory scale. - Microorganisms and environment: Microorganisms and environment, Water Microbiology. Management of toxic industrial wastes. - Physical and chemical methods of control of microorganisms. Microbial integrations. Food industry waste as fermentation substrate.

SECTION- B

Definition of food, food science, and food technology. Professional bodies both in India and abroad dealing with food technology. General introduction of food preservation. Historical developments. Contamination of foods by microorganisms from natural sources, spoilage of different foods – general principles, causes and spoilage and growth of microorganisms in foods. Food intoxicants, mycotoxins, food poisoning and food infections-investigation of a food borne disease outbreak. Contamination, Food containers: rigid and flexible: glass, metal, plastic, packaging system characteristics and advantages. Charactersitics of plant and animal foods. Causes of food spoilage and methods of prevention.Preservation of foods by: pasteurization, sterilization, drying, radiation, refrigeration, freezing, sugar, salt, chemicals, radiation, microorganisms. Intermediate moisture foods. Fortification and enrichment of foods. Recent trends in food processing and preservation: Introduction to high pressure processing, Hurdle technology, Ohmic heating etc. General principles of food hygiene in food handling, personnels, food processing plants. Impurities in water and its treatment. Sanitation facities and procedures in food processing plants. Application of mathematical techniques to describe food processing operations such as drying, rheology, degradation of nutrients and pigments during processing and storage. Use of semi-log and log-log paper.

1. Potter, N.N : Food Science, CBS publication, New Delhi, 2005
2. Desrosier and Desrosier : Technology of Food Preservation CBS publication,New Delhi, 2006
3. Frazier : Food Microbiology, Tata McGraw Hill, New Delhi

Title	**FLUID FLOW**			**Credits**	4
Code	PCC-CS 102	**Semester:-**3rd		**L T P**	3 1 -
Max.Marks	**End term- 50**	**Mid term- 50**	**Practical -**	**Elective**	N
Pre requisites				**Contact Hours**	60
THEORY			**Time**		3 Hours
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
Course Outcomes	CO1: Understand and solve hydrostatic problems related to forces on submerged bodies and pressure measurement. CO2: Derive & apply basic equations of fluid flow; understand fluid flow phenomena. CO3: Understand the flow of incompressible fluids, examine energy losses in pipe transitions and evaluate pressure drop in pipe flow using Hagen-Poiseulli equation. CO4: Apply the concepts of dimensional analysis to various fluid flow problems. CO5: Understand compressible flow and flow measurement devices. CO6: Understand fluid machineries including pumps, blowers and compressors.				

SECTION- A

Fluid Statics: Normal forces in fluids, Pressure Measurements, Forces on Submerged bodies, Buoyancy and Stability.

Fluid Properties: Newtonian and non-Newtonian Fluids, Nature of Turbulence, Eddy Viscosity, Flow in Boundary Layers, Basic Equation of Fluid Flow, Bernoulli's Equation, Navier stokes equation.

Flow of Incompressible Fluids: Laminar and Turbulent flow in pipes, Velocity Distribution in Pipes, Frictional Losses in Pipes and Fittings, Fanning equation, Estimation of economic pipe diameter. Derivation of HAGEN-POISEULLI and f=16/Re equations.

SECTION- B

Dimensional analysis and its Applications to Fluid Flow.

Flow of compressible fluids: Compressible flow and flow through nozzles.
Flow Measurements: Pilot tube, Orifice, Venturi, Rotameter and Notches, wet gas metre etc.
Fluid Machinery: Classification and Performance of Pumps, Turbines, Compressors, and Blowers,Selection and Specification, Net positive Suction Head.

***Books Recommended*:**

1. Mc Cabe, W.L. and Smith, J.C. : Unit Operation of Chemical Engineering, McGraw Hill.
2. Fox, R.W. and McDonald, A.T. : Introduction of Fluid Mechanics (SI Version) 4th ed. John Wiley and Sons, 1996.
3. Coulson, J.M. and Richardson, J.F. : Chemical Engineering, Vol. I, Pergamon
4. Foust, A.S., Wensel, L.A., Clump, C.W., Maus, L. and Anderson, L. : Principles of Unit Operations, John Wiley.
5. Badger, W.L. and Banchero, J.T. : Introduction to Chemical Engineering, Tata McGraw Hill Pub. Co. Ltd., 1997.
6. Chattopadhya, P. : Unit Operations of Chemical Engineering, Vol. I, Khanna Publishers, Delhi, 1997.

Title	**BIOCHEMISTRY & NUTRITION**			**Credits**	3
Code	FT 102	**Semester:-**3rd		**L T P**	3 - -
Max. Marks	**End term- 40**	**Mid term-35**	**Practical- -**	**Elective**	N
Pre requisites				**Contact Hours**	45

THEORY	**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.	
Course Objectives	1. *The students will learn about the biological basis of nutrition and various metabolic pathways by which food influence health.* 2. *They will understand the mechanisms by which diet can influence health and help them develop laboratory skills required for modern biochemical and molecular studies of nutrition.*	
Course Outcomes	CO1 Introduce students to basis of biological catalysts and their function in metabolic pathways. CO2 Provides information about energy produced from lipids and proteins. CO3 Provides information regarding biotechnological concepts and their applications. CO4 Understanding the knowledge about the role of nutrition in maintaining good health.	

SECTION- A

Introduction to biochemical science, Enzymes and coenzymes. Introduction, definition, nomenclature, classification, numbering structure and functions of water-soluble enzymes, energy-rich compounds, active sites, mechanism of enzymes action, effect of temperature, pH, enzyme concentration and substrate concentration on the rate of enzyme reaction, specificity of enzymes, enzyme inhibition, kinetics of enzymes action, activation of enzymes, nature and functions of enzymes involved in digestion.
Metabolism of Carbohydrates: Respiratory quotient, Embden-Meyerhoff pathway, Cori and Cori Cycle, Kreb's Cycle, electron transport chain, oxidative phosphorylation.
Metabolisms of Lipids: Digestion and absorption of lipids, fatty liver, lipotropic agent, oxidation pathway, methylmalonyl Co- pathway metabolism of ketone bodies, energy balance.

Metabolism of Proteins: Digestion and absorption of proteins, amino acids or nitrogen pool, nitrogen balance, general metabolism of proteins and amino acids. Nitrogen fixation.
SECTION- B
Nucleic Acids and their Components: Bases, nucleotides and nucleotides (cyclic also). Structures of different types of RNA and DNA. Physiochemical properties of DNA and RNA. Nucleoproteins. Replication, Transcription and Translation. *Biotechnological Concepts*: Vectors used for recombinant DNA technology. Application of cloned DNA, Screening of newly synthesized DNA. *Introduction to Human Nutrition*: The functions of foods. The need for energy, basal energy metabolism. Energy value of foods. Protein quality, Dietary allowances and standards for different age groups, nutritive value of foods. Dietary interrelationship, techniques for assessment of human nutrition. Physiological functions, deficiency, role in metabolism and daily requirements of Vitamin A, D, E, K, C, B1, B2, niacin, pyridoxin, cyanocobalamine, folic.acid, choline, p-aminobenzoic acid. Minerals as structural and functional constituents in human metabolism, specific role of iron, calcium, phosphorus, iodine, sodium, chlorine, potassium, copper, and magnesium.

Books Recommended:

1. Lehninger : Biochemistry, Mac Millan Publisher.
2. Stryer : Biochemistry, Freeman Publisher
3. Conn and Stumpf . : Outlines of Biochemistry, John Wiley & Sons, New York, 1995.
4. Swaminathan : Nutrition.
   Nutritive Value of Indian Food
5. Gopalan, Rama Sastri & Balasubramanium

Title	**CHEMICAL ENGINEERING THERMODYNAMICS**			**Credits**	4
Code	PCC-CS 105	**Semester:-** 3rd		**L T P**	3 1 -
Max. Marks	**End term- 50**	**Mid term- 50**	**Practical-**	**Elective**	N
Pre requisites				**Contact Hours**	60
THEORY				**Time**	3 Hours
Course Outcomes	CO1: Understand the First and Second Laws of Thermodynamics apply it to open and closed systems, steady and unsteady state processes, isothermal and adiabatic processes and solve related engineering problems. CO2: Estimate the thermodynamic properties of pure substances, especially fluids. Knowledge of various PVT equations of state including Principle of corresponding states and heat capacities to evaluate thermodynamic properties of fluids. CO3: Explain the underlying principles of phase equilibrium and evaluate the thermodynamic properties in two-component and multi-component systems CO4: To develop and ability to envisage intermolecular potential and excess property behaviour of multi-component systems CO5: Impart ability to apply the concepts of phase equilibrium to vapour liquid equilibrium (VLE), separation processes and chemical reaction equilibrium				
Note for the	The semester question paper of the subject will be of 50 marks having 8 questions of equal				

Examiner	marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.

SECTION- A

Brief review of the terms: state functions, types of systems, internal energy, heat and work and reversible and irreversible processes. First Law of Thermodynamics and its Engineering Applications i.e. constant volume processes, constant pressure processes, isothermal and adiabatic processes, pumps, turbines, compressors, nozzles, heat exchangers, pitot tube, venturimeter and orifice meter. Throttling Processes, Joule-Thomson Coefficient, liquefication of gases, thermochemistry includes a brief review of heat capacities and their measurement, standard heat of reaction, standard heat of formation, standard heat of combustion, flame temperature, H-x diagrams, heat of solution, partial, molar enthalpies, enthalpy for phase change etc. Equation of state for real gases and their mixtures. Principle of corresponding states and generalized compressibility factor.

Review of Second law of thermodynamics, entropy concept, Entropy and lost work calculations. Microscopic interpretation of entropy. Third Law of thermodynamics and its applications. Free energy functions and their significance in phase and chemical equilibria, Clapeyron's equation and some important correlations for estimating vapor pressures. Estimation of thermodynamic properties by using graphs and tables.

SECTION- B

Phase Equilibria:

Partial molar properties, partial molar Gibbs free energy, Chemical potential and its dependence on temperature and pressure Ideal solutions (Lewis-Randel Rule).

Fugacity and its calculations. Dependence of fugacity of temperatures and pressure

Solution behaviour of real liquids and solids. Activity and activity coefficients. Variation of activity co-efficient with temperature and composition. Activity coefficients of electrolytes standard states. Properties of mixing. Excess Properties, Gibbs-Duhem equation and its application to vapour-liquid equilibria.

Chemical Equilibria:

Equilibrium constant in terms of measurable properties variations of equilibrium constant with temperature and pressure.

Adiabatic reactions, Gibbs phase rule, equilibria in heterogeneous reactions.

***Books Recommended*:**

1. Smith, J.M., Van Ness, H.C. and Abbott, M.M. : Introduction to Chemical Engineering Thermodynamics, 7th Edition, McGraw Hill Professional, 2005
2. Elliott, J.R and Lira, C.T. : Introductory Chemical Engineering Thermodynamic, Prentice Hall PTR., 1999.
3. Rao, Y.V.C. : Chemical Engg. Thermodynamics, Orient Blackswan, 1997.
4. Dodge, B.F. : Chemical Engg. Thermodynamics, McGraw Hill, 1944, Original from the University of Michigan, 2007.
5. Narayanan, K.V. : A Textbook of Chemical Engineering Thermodynamics, PHI Learning Pvt. Ltd., 2004.

Title	**MECHANICAL OPERATIONS**			**Credits**	4
Code	PCC-CS 106	**Semester:-**3rd		**L T P**	3 1 -
Max. Marks	**End term- 50**	**Mid term- 50**	**Practical-**	**Elective**	N
Pre requisites				**Contact Hours**	60

THEORY		**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 60 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.		
Course outcomes	CO1: Understand and determine various properties of solids, specific surface area, average particle sizes of particles in mixtures, sphericity and laws of crushing. Classification of SR equipments, power consumption of various machines, description and working of Size reduction equipments and their applications CO2: Understand various screening techniques and equipments, capacity and effectiveness of screens, standard screens CO3: Understand and apply knowledge of Filtration Processes , constant pressure and constant volume filtration and various filtration equipments, their types and applications CO4: Understanding and applying concepts of Flow around a single particle, drag force and drag coefficient, settling velocity of particles in a fluid, hindered and free settling of particles, thickening and gravity separation, types of settling devices. CO5: analyzing flow through a bed of particles, applications of fluidization & fluidized bed, conditions for fluidization, minimum fluidization velocity, types and applications of fluidization. CO6: Understand and applying concepts of Handling, Storage and Transportation of Solids, Agitation of liquids, axial flow impellers, radial flow impellers, design of agitators, velocity and power consumption of agitated vessels, blending & mixing.		

SECTION- A

Size Reduction: Crushers and Grinders: jaw crusher, crushing rolls, Gyratory Crusher Tumbling/revolving mills, hammer Mill and Fluid energy mill. Closed and open circuits grinding. Power requirements. Laws of crushing.

Mechanical Separation: Screening: Stationery screens, Grizzlies, Trommel and Vibrating screens. International Standard Screens & Indian Standard Screens. Screening Analysis-differential and cumulative.

- Motion of particle through a fluid: Stoke's Newton's law. Free and hindered setting.
- Setting tank and double cone classifiers
- Batch and continuous thickeners

Settling chamber, cyclone, filter bag and electrostatic precipitators.

SECTION- B

Filtration: Plate and frame filter press, continuous rotary vacuum filter, filter aids, theory of filtration for non-compressible cakes.

Centrifugation: Tubular bowl centrifuge, disk centrifuge and batch basket centrifuge.

Fluidization: Conditions for fluidization: Aggregate and particulate fluidization. Ergun's and Carman-Kozeny equations.

Mixing and Agitation: Basic ideas and characteristics of mixing equipment power consumptions scale-up.

Conveying: Mechanical and pneumatic conveying systems, storage & handling of materials.

***Books Recommended*:**

1. Mc Cabe, Warren L., Smith, Juluain C. and Harroit, Peter : Unit Operations of Chemical Engineering, 5th Edition, Mc Graw Hill Int. ed (Chemical Engineering Series) Mc Graw Hill Book Company, New York, 1993.
2. Foust, Alan S., Wenseli, Leonard A., Clump, Curtis W., mans, Louis and Anersen, L. Bryce : Principles of Unit Operations, Wiley International Edition, John Wiley & Sons Inc., New York.
3. Coulson, J.M. and Richardson, J.F. : Unit Operations (Volume 2 of Chemical Engineering) New York: Mc Graw – Hill Book Co;, Inc.

4. Gupta, Santosh K. : Momentum Transfer Operations, Tata McGraw-Hill, New Delhi.
5. Badger, Walter L. and Banchero, Julius T. : Introduction to Chemical Engineering, Mc Graw-Hill, Kogakusha Ltd., New Delhi.
6. Brown, C.G. : Unit Operations, John Wiley & Sons, Inc., New York.
7. Chattopadhyay, P. : Unit Operations of Chemical Engineering, Vol. I, Khanna Publishers, New Delhi.

Paper Title : Elements of Bio & Food Science Lab.
Paper Code FT 151 Max. Marks : 25 Credits : 1
Course Objectives:

1. Understanding the microorganisms associated with foods and isolation methods of microorganisms from foods.
2. Learning the fermentation process and microorganisms involved in the production of fermented foods.
3. Name and describing the beneficial and spoilage microorganisms associated with food.

Course Outcomes:
CO1 Understand working principle of microscopes and sterilization techniques.
CO2 Use aseptic technique to properly handle microorganisms to avoid contamination.
CO3 Identify the microorganisms using staining techniques.
CO4 Understand and apply the knowledge to handle microscopes to observe stained microorganisms.
CO5 Isolate the pure culture from mixed population found in contaminated foods.

Use of microscopic technique for identification of microorganisms on the basis of cell morphology and specific staining technique.
Isolation of pure cultures of bacteria, yeasts, moulds and taxonomic identification on the basis of morphology and physiology.
Preparation of nutrient broth and media with agar, gelatin and specific media for culture of microorganisms.
Microorganisms are Ubiquitous and concept of aseptic conditions while cooking Gram's Staining Dilution's, pour plating, spread plating, streaking. Media preparation & strelization. Microbial growth determination by - O.D. and Viable Counting. Phenol-Coefficient: Concept and Determination of those of germicides available in market. Microbiological assay of water. Enzyme production and assay. Measurement of activity of anti-microbial agents for the control of microorganisms in foods.

Paper Title : BIOCHEMISTRY & NUTRITION Lab.
CO1 Describe various separation and quantification techniques frequently used for food analysis.
CO2 Demonstrate the presence of protein, lipid, carbohydrate and water in food using chemical methods.
CO3 Apply their knowledge in food biochemistry and nutrition in designing new range of products with improved nutritional characteristics
CO4 Evaluate proper selection and application of appropriate methods of analysis.
Paper Code FT 152 Max. Marks : 25 Credits : 1
Analytical techniques in Bio-Chemistry, isolation and pu rification of enzyme, Determination of activity of enzyme, preparation, specificity, inhibition and kinetics of enzymatic reaction. Detection and estimation of amino acid by paper and column chromatography. Assessment of nutritive value of foods.

Paper Title: FLUID Flow Lab.

CO1: Verify Bernoulli's theorem.
CO2: Evaluate discharge coefficient for various flow measurement devices and understand their industrial applications.
CO3: Identify various types of flow, valves and fittings and evaluate the frictional losses associated with them.
CO4: Calibrate a given flow meter.
CO5: Understand the characteristics of pumps.
CO6: Verify *f=16/Re* for laminar flow through a straight tube.

Paper Code PCC-CS 152 Max. Marks 40 Credits: 1.5

1. General study of pipe fittings, valves and other equipments in the unit operations laboratory.
2. Pressure drop for flow through pipelines, valves & fittings.
3. Characteristics of pumps.
4. Flow measurement by the use of orifice meter, venturimeter, rotameter & pitot tube.
5. Flow over weirs and notches.
6. Flow measurement of compressible fluids.

Paper Title : MECHANICAL OPERATIONS Lab.

CO1: Understand the grinding operation and evaluate critical speed of a ball mill.
CO2: Analyze particle size distribution and evaluate screen effectiveness.
CO3: Understand pressure drop behavior for the flow of Newtonian fluid flowing though fixed and fluidized beds.
CO4: Understand the process of filtration and apply the basic equations of filtration.
CO5: Understand settling rate and behavior of particles falling in quiescent liquid.

Paper Code PCC-CS 155 Max. Marks 40 Credits: 1.5

1. Pressure drop and two phase flow characteristics in packed and fluidized beds.
2. Measurement of drag force.
3. Batch settling of slurries.
4. Constant pressure filtration.
5. Mixing, crushing, grinding, screening and particle size analysis (Anderson Pipette)

4th SEMESTER

Title	**HEAT TRANSFER**			**Credits**	4
Code	PCC-CS 104	**Semester:-**4th		**L T P**	3 1 -
Max. Marks	**End term- 50**	**Mid term- 50**	**Practical- 1**	**Elective**	N
Pre requisites				**Contact Hours**	60

THEORY		**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.		
Course Outcomes	CO1: To understand conduction, convection and radiation modes of heat transfer and to estimate heat transfer rates, CO2: To understand boiling and condensation phenomena CO3: To carryout thermal analysis of heat exchanger using LMTD and effectiveness method, CO4: To estimate steam economy, capacity of single and multiple-effect evaporators. CO5: To apply engineering judgment including an appreciation of cost and safety.		

SECTION- A

Conduction: Steady state conduction in one dimensional system, general conduction equation, effect of variable thermal conductivity, steady state conduction involving internal heat generation, lagging on pipes, the critical thickness of insulation on pipes, extended surfaces of uniform thickness and fin effectiveness, fin efficiency.

Convection: Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations.

Radiation Heat Transfer: Black Body radiation, and grey body radiation, physical mechanism, radiation properties and shape factor, heat exchange between non-black bodies, radiation shields pyrometry and effect of radiation on temperature measurement

SECTION- B

Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling.

Evaporation: Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding.

Heat Exchangers: Various types of heat exchangers, overall heat transfer coefficients, heat exchanger mean temperature differences, heat exchanger effectiveness and the number of transfer units.

***Books Recommended*:**

1. Mc Cabe, W.L., Smith, J.C. : Unit Operations of Chemical Engineering McGraw Hill.
2. Holman, J.P. : Heat Transfer, McGraw Hill Book Co.
3. Mc Adams, W.H. : Heat Transmission, McGraw Hill Book Co.

4. Chapmann, A.J. : Heat Transfer, Mc Millan Publishing Co.
5. Kern, D.Q. : Process heat Transfer, McGraw Hill Book Co.
6. Kreith, F. : Principles of Heat Transfer, Harper & Row Pub., London.
7. Geankoplis, C.J. : Transport Processes and Unit Operations, Prentice Hall of India Pvt. Ltd., 3rd Edition, 1999.

Title	**Food Chemistry**			**Credits**	3
Code	FT 103	**Semester:-**3rd		**L T P**	3 - -
Max. Marks	**End term- 40**	**Mid term- 35**	**Practical- -**	**Elective**	N
Pre requisites				**Contact Hours**	45
Course Outcomes	CO1 The students will gain knowledge about various components of foods, their importance and deficiency, effect of processing condition on nutrition value of foods. CO2 The Students will be able to apply that knowledge during process condition optimization of different food product manufacturing and quality mentainance. CO3 The Students will be able to apply the knowledge during processing so that loss of vitamins and nutrient loss will be minimum. CO4 The students will be able to be able to implement the knowledge during fibre rich product development and food gel development.				
THEORY				**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
SECTION- A					
Moisture in foods : Hydrogen bonding, bound water, water activity. Carbohydrates: Definition, classification and nomenclature. General properties (physical and chemical) of sugar. Reducing and non-reducing sugars. Common monosaccharides, di-saccharides and poly-saccharides. Chemistry of starch, cellulose, gums and mucilage. Crude fibre. Protein: Classification. Amino acid sequence in proteins, pleated sheet and helix structure of proteins. Molecular weight of proteins and ultra-centrifuge separation and purification of proteins. Physical and chemical properties of amino acids. Chromatographic separation of amino acids. Food proteins and their characteristics. Protein denaturation.					
SECTION- B					
Lipids : Classification. Occurance in foods and composition, identification of natural fats and oils in foods. Physical (melting point, softening point, slipping point, short melting point, specific gravity, refractive index, smoke-flash and fire point, turbidity point) and chemical properties. Flavor changes in fats and oils. Natural pigments and Flavouring Agents: Chlorophylls, carotenoids, anthocyanins, anthoxanthins, flavonoids, tannins and natural flavour constituents. Saponins, Alkaloids. Pectic substances-Protopectin, pectin gels, Importance of Pectin in food products. *Vitamins:* Occurance and chemistry of various vitamins: A, B, C, D, E, K. ,Losses during processing and storage. *Food Additives:* Types; Methods for safety levelanalysis, color additives legislation.					

Recommended Books.

1 L.H. Meyer, C.B.S. Publishers, Delhi, 1987 : Food Chemistry

2 Fenamma : Food chemistry
3 de Man: Food Chemistry

Title	**Food Microbiology**			**Credits**	04
Code	FT 104	**Semester:-**4th		**L T P**	3 - -
Max. Marks	**End term- 40**	**Mid term- 35**	**Practical- -**	**Elective**	N
Pre requisites				**Contact Hours**	45
THEORY				**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
Course Objectives	1. *To make students aware about different concepts involved in food spoilage and its prevention by using different food preservation principles and technologies.* *To familiarize students with procedures and techniques used to detect and enumerate microorganisms in foods.*				
Course Outcomes	CO1 Identify different types of microorganisms present in the environment responsible for spoilage of food and evaluate the measures required to control undesired microorganisms in food. CO2 Interpret the effects and causes of various food borne diseases and steps involved in investigating an outbreak. CO3 Understand the technology and microbiology behind various fermented products along with their health benefits and various microbiological methods used for analysis of micro-organisms in food. CO4 Understand the importance of maintaining safety and hygiene in food industry and various approaches used for sanitation of plants and equipments.				
SECTION- A					
Contamination of foods by microorganisms from natural sources, spoilage of different foods: general principles, causes and spoilage and growth of microorganisms in foods Preservation of foods by different preservation methods, contamination, preservation and spoilage of different food products. Food poisoning and food infections – investigation of food borne disease outbreak. Microbiology of individual food products. Dairy products, bread.					
SECTION- B					
Food from microbes: Fermented foods. Microbial flavour – fragrances. Food Allergies. Antimicrobial agents used in foods. Rapid methods for microbiological analysis of foods. Food processing plant, hygiene and sanitation: Importance of hygiene and sanitation. Chemicals and methods used in sanitation of plant and equipments.					

Books Recommended:

1. Prescott, Herley, Klein : Microbiology, 2nd Edition, Tata McGraw Hill.
2. Stain : General Microbiology.
3. Salley : Bacteriology, Tata McGraw Hill.
4. Prescott & Dunn : Industrial Microbiology, CBS Publishers.
5. Casida : Industrial Microbiology, John Wiley.
6. Pelczar : Microbiology, Tata McGraw Hill.

7. Frazier : Food Microbiology, Tata McGraw Hill, India.

Title	**PROCESSING OF CEREALS & PULSES**			**Credits**	05
Code	FT 301	**Semester:-**4th		**L T P**	3 1 -
Max. Marks	**End term- 50**	**Mid term- 50**	**Practical- -**	**Elective**	N
Pre requisites				**Contact Hours**	60
THEORY				**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
Course Objectives	1. *To acquaint students with production, structure, composition, quality evaluation of various cereals.* 2. *Students will get exposure of processing technologies of cereals, pulses and storage of cereals.* 3. *To learn about technologies for product development and value addition of various cereals and pulses.*				
Course Outcomes	CO1 The students will be able to gain knowledge about the basic composition and structural parts of food grains. They will become aware about paddy processing and rice milling equipments. CO2 They will know about wheat processing and basic rheology of wheat dough which will help them for developing entrepreneurial skills and apply the knowledge to process food grains into value added products. CO3 Study the processing and milling of maize which will promote gainful employment. They will also gain knowledge about the various products made from processing of maize. CO4 They will develop skills needed in the milling of pulses. Students will also become familiar with hygienic and safe handling of Cereal Products.				
SECTION- A					
Composition, structure and quality, characteristics of cereal grains and pulses. Paddy Milling: Principles of milling of paddy. Traditional and modem methods of paddy milling. Parboiling of paddy, Paddy milling machinery. Processed foods from rice, byproducts of paddy milling and their uses. Milling of Wheat: Criteria of wheat and flour quality, flour milling, wheat milling machinery. Rheology and Chemistry of dough, Physical dough testing instruments. Technology of baking bread, biscuit, cookies, cakes. Durum wheat and pasta products like macaroni, noodles and spaghetti. Cereal based infant foods. fixation.					
SECTION- B					
Corn Milling: Dry and wet milling of corn, corn based ready to eat breakfast cereals. Corn oilprocessing and utilization, Corn starch modification and uses, Corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose, maltodextrin. Milling of Pulses: Different methods of pulse milling. Pulse milling machinery. Application of enzymes in processing of cereals and pulses processing. Sanitation in the processing plant. Design of equipment used in milling of wheat, rice, corn and pulses. Plant layout.					

Books Recommended:

1. Kent, N.L. : Technology of Cereals, CBS Publisher
2. Pomeranz, Y. : : Wheat Chemistry and Technology, CHIPS Book, USA.
3. Tanley A. Watson & Paul E. Ramstad : Corn Chemistry and Technology, ADCC, USA..

4. Julliano, B.O. : Rice Chemistry and Technology, AACC, USA.

Title	**STRENGTH OF MATERIALS**			**Credits**	3
Code	ESC-GES 105	**Semester:-**4th		**L T P**	3 - -
Max. Marks	**End term- 40**	**Mid term- 35**	**Practical- -**	**Elective**	N
Pre requisites				**Contact Hours**	45
THEORY				**Time**	3 Hours
Note for the Examiner	The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.				
Course Objectives	1. To make the students understand the basic concepts and principles of strength of materials. 2. To give ability to calculate stresses and deformations of objects under loading. 3. To make students able to apply the knowledge of strength of materials on engineering applications and design problems.				
Course Outcomes	CO1: Identify various types of Stressers and Strains, define Hooke's law, modulus of dlasticity and modulus of rigidity, calculate stresses under impact loads and sudden applied loads under varying conditions. CO2: Apply the theory to solve numerical problems based on Shearing force, bending moment, types of load on beams, types of supports, Concentrated loads and uniformly distributed loads. CO3: Define different types of Struts and Columns, Explain Euler theory and its limitations, describe Rankine-Gordon formula and its applications to numerical problems. CO4: Describe Stresses and Strains in Thin Shells and in springs, Strain Energy and Theories of Elastic Failure and numerical problems.				

SECTION- A

Stresses and Strains: *Concept of simple stress and simple strain,* mechanical properties of solids, types of load, Tensile stress , compressive stress, shear stress, complementary shear stress, thermal stresses, tensile test , stress strain curve , Hooke's law, modulus of elasticity, modulus of rigidity, Principle of St. Venant strain, factor of safety, compound bars, , Compound Stresses and Compound Strains in two-dimensional stress system , Stresses on oblique plane due to pure shear, principle planes and principle stresses, maximum shear stress, Mohr's circle of stress, Poisson's ratio, volumetric strain, elastic constants and relations between them.

Shearing Force and Bending Moments in Beams: Shearing force, bending moment, types of beams, types of load on beams, types of supports, sign- conventions for shearing force and bending moment, point of inflection , relations between bending moment and shearing force shearing force and bending moment diagrams for beam under different loads. Concentrated loads, uniformly distributed loads, numerical problems.

Bending Stresses and Shearing Stresses in Beams: Pure bending, graphical determination of moments of inertia, bending stress, composite beams, reinforced concrete beams, General eccentric loading, combined direct and bending stresses, eccentric longitudinal loads , Shear stress distribution in rectangular section and circular section, numerical problems.

Deflection of Beam: Introduction, Macauly's integration method, simply supported beam with load at mid span and beam with eccentric load, moment area method, deflection due to shear, numerical problems.

SECTION-B

Torsion of Shafts: Torsion of thin circular shaft, composite shaft, combined bending and torsion. equivalent torque, equivalent bending moment, numerical problems.

Struts and Columns: Definition of strut and column, Euler's Column theory and assumptions made, Strut with both ends pinned, strut with one end fixed and one end free, strut with both ends free, Slenderness ratio, limitations of Euler theory, Rankine's Empirical formula, strut with eccentric loading, numerical problems.

Stresses and Strains in Thin Shells: Thin cylinder under internal pressure, thin spherical shell under internal pressure, volumetric strain, modifications for built-up shells, numerical problems.

Stresses and Strains in Springs: Types of Springs, stresses in Close coiled helical springs, open coiled helical springs, leaf springs, springs in parallel and in series, numerical problems.

Strain Energy and Theories of Elastic Failure: Strain energy and resilience, Strain energy in tension and compression due to suddenly applied load and impact loads, strain energy due to shear, strain energy due to bending, strain energy due to torsion, theories of elastic failure and their graphical representation, numerical problems.

Books Recommended:

1. Ryder, G. H. : Strength of Materials, 3rd Edition S.I. Units Macmillan, 1969.
2. Bedi, D. S. : Strength of Materials, 6th Edition Khana Book Publishing Co. (P)Ltd.
3. Timoshenko, S. : Strength of Materials Part-I, 3rd Edition, Cbs Publishers, 1986.
4. Singal & Sharma : Strength of Materials , Modern Publisher.

Title	**PROCESS EQUIPMENT DESIGN**			**Credits**	1.5
Code	ESS-GES 157	**Semester:-**4th		**L T P**	- - 3
Max. Marks	**End term- -**	**Mid term- -**	**Practical- 40**	**Elective**	N
Pre requisites				**Contact Hours**	45
PRACTICAL					
Objectives	To be familiar with the process and mechanical aspects of design of process equipments, various design factors, design procedures, design codes and standards.				
Course outcomes	CO1: Understand general design consideration, codes and specifications for pressure vessels. CO2: Design of thin-walled vessels under internal as well as external pressure. CO3: Design of foundation, supports and various joints.				

LIST OF PRACTICALS

1. Study of factors influencing the design of vessels; classification of pressure vessels,applications, method of fabrications, fundamental principles and equations.
2. Study of pressure vessel codes specifications and standards; Review of code and its development, ASME codes, API-ASME code, Section VIII of ASME codes
3. General design considerations for pressure vessels; Design pressure, design temperature, materials, design stress (nominal design strength), corrosion allowance, design loads, minimum practical wall thickness.
4. Design of thin-walled vessels under internal pressure; Cylinders and spherical shells, heads

and closures, design of flat ends, design of domes ends, conical sections and end closures.

5. Design of vessels subject to external pressure; Cylindrical shells, design of stiffening rings, vessels heads.
6. Design of vessels subject to combined loading: Weight loads, wind loads (tall vessels), torque.
7. Design of welded joints and Bolted flanged joints.
8. Design of Foundation and supports.

***Books Recommended*:**

1. Battacharyya, B.C. : Introduction to Chemical Equipment Design Mechanical aspects, Chemical Engineering Education Development Centre.
2. Brownell and Young : Process Equipment Design , Willey Publication
3. Joshi, M.V. : Process Equipment Design, Macmillan India.

Paper Title : HEAT TRANSFER Lab.

CO1: Determination of heat transfer coefficient for different types of heat transfer equipment and Unsteady state heat transfer in jacketed vessels.

CO2: Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface & heat losses for insulated pipes.

CO3: Study of double pipe heat exchanger and 1, 2 - shell and tube heat exchanger.

CO4: Study and operation of long tube, forced circulation and multiple effect evaporators, Duhring plot for solutions involving nonvolatile solutes

Paper Code PCC-CS 154 Max. Marks 40 Credits : 1.5

1. Determination of heat transfer coefficient for different types of heat transfer equipment. Wilson plots.
2. Unsteady state heat transfer in jacketed vessels. (Open pan evaporator)
3. Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface.
4. Determination of heat losses for insulated pipes
5. Study of double pipe heat exchanger and to determine overall heat transfer coefficient
6. Study the performance characteristics of a 1,2 - shell and tube heat exchanger
7. Study and **operation** of long tube, forced circulation and multiple effect evaporators.
8. Duhring plot for solutions involving nonvolatile solutes

Paper Title : P{ROCESSING OF CEREALS & PULSES LAB.

CO1- Student will be able to apply their knowledge in the cereal processing industry.

CO2- Students will be able to optimize new cereal product development or fortification of different additives maintaining its quality and nutritional values.

CO3- Study the processing and milling of wheat, rice maize which will promote gainful employment..

CO4- Students will also become familiar with hygienic and safe handling of Cereal Products.

Paper Code FT 155 Max. Marks : 25 Credits : 1

1. Milling of wheat. Evaluation of properties of wheat and milled products
2. Physical, chemical and rheological.
3. Baking of bread, biscuit, cake, pastries. - Evaluation of baked bread. –
4. Evaluation of properties of rice (physical and chemical). - Cooking quality of rice. - Experiment on parboiling, evaluation of quality. - Milling of rice, assessment of degree of polishing.
5. Milling of pulses. –

6. Visit to flour mill, rice mill and pulse mill industries.

Paper Title : FOOD CHEMISTRY Lab.

CO1: Student will be able to implement the practical knowledge of food analysis in industrial scale analysis of food material.

CO2: Students will be able to detect adulterants in food products.

CO3: Students will be able to maintain the quality of fresh food products.

CO4: Students will be able to maintain quality of food products during storage at different atmospheric conditions.

Paper Code FT 153 Max. Marks : 25 Credits : 1

1. Preparation of samples for analyses.
2. Determination of moisture content (wet basis and dry basis).
3. Ash: total, acid soluble, alkali soluble and water soluble.
4. Lipids, protein, crude fibre, reducing and non-reducing sugar.
5. Estimation of ascorbic acid, vitamin-A, chlorophyll, carotenoids etc.
6. Estimation of iron, copper, lead, tin etc.

Paper Title : FOOD MICROBIOLOGY Lab.

Course outcome(s):

CO1 Explain various methods of isolation, characterization and screening of bacteria, fungi and other related organisms.
CO2 Apply different preservation techniques relative to food safety and spoilage.
CO3 Enumerate the microorganisms to check the quality characteristics of food.
CO4 Illustrate the growth requirements of common food borne pathogens and spoilage microorganisms.
CO5 Identify which organisms would be likely to grow in a specific food product.

Paper Code FT 154 Max. Marks : 25 Credits : 1

Bacteriological examination of foods: General protocol taking the examples of different foods. Presumptive coliform test of milk, butter, cream, ice-cream and dahi. Standard plate count for pasteurized milk and ice-cream. Yeast and mold count for butter, dahi and bread. To access bacteriological quality of milk by methylene blue reduction test and resazurin reduction test.

FIFTH SEMESTER

Title	**HEAT TRANSFER**			**Credits**	05
Code	CHE 204	**Semester:-**5th		**L T P**	3 1 3
Max.Marks	**End term-50**	**Mid term- 50**	**Practical --25**	**Elective**	N
Pre requisites				**Contact Hours**	42 (Theory) 14 (Practical Sessions)

THEORY		**Time**	4 Hours
Course Outcomes	CO1: To understand conduction, convection and radiation modes of heat transfer and to estimate heat transfer rates, CO2: To understand boiling and condensation phenomena CO3: To carryout thermal analysis of heat exchanger using LMTD and effectiveness method, CO4: To estimate steam economy, capacity of single and multiple-effect evaporators. CO5: To apply engineering judgment including an appreciation of cost and safety.		
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.		

SECTION- A

Conduction: Steady state conduction in one dimensional system, general conduction equation, effect of variable thermal conductivity, steady state conduction involving internal heat generation, lagging on pipes, the critical thickness of insulation on pipes, extended surfaces of uniform thickness and fin effectiveness, fin efficiency. Convection: Free and forced convection, concept of heat transfer co-efficient, dimensionless numbers in free and forced convection, Dimensional analysis, Determination of Heat transfer coefficient using heat and momentum transfer analogies, experimental determination of heat transfer coefficient and common working correlations. 32 Radiation Heat Transfer: Black Body radiation, and grey body radiation, physical mechanism, radiation properties and shape factor, heat exchange between non-black bodies, radiation shields pyrometry and effect of radiation on temperature measurement.

SECTION- B

Condensation and Boiling: Condensation heat transfer phenomenon, film condensation on vertical plates and cylinders as well as on horizontal cylinders. Effects of non-condensable gases and vapor velocity on condensation, pool boiling, forced convection boiling, working correlations for pool boiling. Evaporation: Types of Evaporators, single and multiple effects, single and multiple effects calculations, evaporator capacity, economy, effect of liquid head and boiling point elevation, methods of feeding. Heat Exchangers: Various types of heat exchangers, overall heat transfer coefficients, heat exchanger mean temperature differences, heat exchanger effectiveness and the number of transfer units.

1. 1. Mc Cabe, W.L., Smith, J.C. 3. 4. 5. 6. 7. : Unit Operations of Chemical Engineering McGraw Hill.
2. Holman, J.P. : Heat Transfer, McGraw Hill Book Co.
3. Mc Adams, W.H. : : Heat Transmission, McGraw Hill Book Co.
4. Chapmann, A.J. Heat Transfer, Mc Millan Publishing Co.
5. Kern, D.Q. : Process heat Transfer, McGraw Hill Book Co.
6. Kreith, F. : Principles of Heat Transfer, Harper & Row Pub., London.
7. Geankoplis, C.J. : Transport Processes and Unit Operations, Prentice Hall

of India Pvt. Ltd., 3rd Edition, 1999.

Paper Title : HEAT TRANSFER (Practical)

CO1: Determination of heat transfer coefficient for different types of heat transfer equipment and Unsteady state heat transfer in jacketed vessels.

CO2: Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface & heat losses for insulated pipes. Study of double pipe heat exchanger and 1, 2 - shell and tube heat exchanger.

CO3: Study and operation of long tube, forced circulation and multiple effect evaporators, Duhring plot for solutions involving nonvolatile solutes

Paper Code CHE 204 Max. Marks 25 Credits : 1

9. Determination of heat transfer coefficient for different types of heat transfer equipment. Wilson plots.
10. Unsteady state heat transfer in jacketed vessels. (Open pan evaporator)
11. Correlation of instantaneous heat transfer coefficients with time study deposition of scale on a heating surface.
12. Determination of heat losses for insulated pipes
13. Study of double pipe heat exchanger and to determine overall heat transfer coefficient
14. Study the performance characteristics of a 1,2 - shell and tube heat exchanger
15. Study and **operation** of long tube, forced circulation and multiple effect evaporators.
16. Duhring plot for solutions involving nonvolatile solutes.

Title	**MASS TRANSFER-I (Theory)**		**Credits**	04
Code	CHE 304	**Semester:-** 5th	**L T P**	3 1 -
Max. Marks	**End term- 50**	**Mid term- 50**	**Elective**	N
Pre requisites			**Contact Hours**	42 (Theory)
THEORY			**Time**	4 Hours
Course Outcomes	CO1: Classify mass transfer operations and laws of mass transfer. CO2: Evaluation of molecular diffusion in gases, liquids and solids. CO3: Discuss diffusion coefficient/Mass transfer coefficient, interphase mass transfer and estimation of number of stages. CO4: Evaluation of humidification operations, design of cooling tower and working of gas-liquid contacting equipments. CO5: Analysis of drying and discuss the working of different types of dryers.			
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.			

SECTION- A

Mass transfer operations, classification of mass transfer operations, choice of separation methods, methods of conducting mass transfer operations, design principles. Introduction to mass transfer and diffusion, molecular diffusion in gases and liquids, diffusion coefficients for gases and liquids, diffusion in solids, types of solid diffusion. Mass transfer coefficients, types of mass transfer coefficients, mass transfer coefficients in laminar flow, theories of mass transfer. Interphase mass transfer, concept of overall mass transfer coefficient.

SECTION- B

Working principle, construction and industrial applications of various gas liquid contacting equipments like sparged vessels, mechanically agitated vessels, tray towers, packed towers, spray chambers, venturi scrubbers. Humidification operations, psychometric chart, adiabatic saturation temperatures, wet bulb temperature, adiabatic operations, types of cooling towers. Principle of drying, batch drying, drying curve, constructional details and working of different dryers.

***Books Recommended*:**

1. 1. Treybal, Robert E. : 4. 5. : Mass Transfer Operations, 3rd Edition. McGraw-Hill, 1981.
2. Sherwood, T.K., Pifford, Robert L. and Wilke, Charles R. : Mass Transfer, McGraw-Hill.
3. 3. Sharma, K.R. : Principles of Mass Transfer, Prentice Hall of India Pvt. Ltd., 2007.
4. McCabe, Warren L., Smith Juliam C. and Harriott, Peter : Unit Operations of Chemical Engg., 7th Edition, McGrawHill, 2005.
5. Sharma, K.R. : Principles of Mass Transfer, Prentice Hall of India Pvt. Ltd., 2007.
6. Coulson & Richardson : : Chemical Engineering, Vol.I (6th Edition, 2009) and Vol. II. (5th Edition, 2006).

Title	**PROCESSING OF CEREALS & PULSES**			**Credits**	05
Code	FT 301	**Semester:-**5th		**L T P**	3 1 2
Max. Marks	**End term- 50**	**Mid term-50**	**Practical- -25**	**Elective**	N
Pre requisites				**Contact Hours**	42 (Theory) 14 (Practical Sessions)
THEORY				**Time**	3 Hours
Course Objectives	4. *To acquaint students with production, structure, composition, quality evaluation of various cereals.* 5. *Students will get exposure of processing technologies of cereals, pulses and storage of cereals.* 6. *To learn about technologies for product development and value addition of various cereals and pulses.*				
Course Outcomes	CO1 The students will be able to gain knowledge about the basic composition and structural parts of food grains. They will become aware about paddy processing and rice milling equipments. CO2 They will know about wheat processing and basic rheology of wheat dough which will help them for developing entrepreneurial skills and apply the knowledge to process food grains into value added products. CO3 Study the processing and milling of maize which will promote gainful employment. They will also gain knowledge about the various products made from processing of maize. CO4 They will develop skills needed in the milling of pulses. Students will also become familiar with hygienic and safe handling of Cereal Products.				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
SECTION- A					
Composition, structure and quality, characteristics of cereal grains and pulses. Paddy Milling: Principles of milling of paddy. Traditional and modem methods of paddy milling. Parboiling of paddy, Paddy milling machinery. Processed foods from rice, byproducts of paddy milling and their uses.					

Milling of Wheat: Criteria of wheat and flour quality, flour milling, wheat milling machinery. Rheology and Chemistry of dough, Physical dough testing instruments. Technology of baking bread, biscuit, cookies, cakes. Durum wheat and pasta products like macaroni, noodles and spaghetti. Cereal based infant foods. fixation.
SECTION- B
Corn Milling: Dry and wet milling of corn, corn based ready to eat breakfast cereals. Corn oilprocessing and utilization, Corn starch modification and uses, Corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose, maltodextrin. Milling of Pulses: Different methods of pulse milling. Pulse milling machinery. Application of enzymes in processing of cereals and pulses processing. Sanitation in the processing plant. Design of equipment used in milling of wheat, rice, corn and pulses. Plant layout.

Books Recommended:

1. Kent, N.L. : Technology of Cereals, CBS Publisher
2. Pomeranz, Y. : : Wheat Chemistry and Technology, CHIPS Book, USA.
3. Tanley A. Watson & Paul E. Ramstad : Corn Chemistry and Technology, ADCC, USA..
4. Julliano, B.O. : Rice Chemistry and Technology, AACC, USA.

Paper Title : CEREALS & PULSES PROCESSING LAB. (Practical)

CO1- Student will be able to apply their knowledge in the cereal processing industry.

CO2- Students will be able to optimize new cereal product development or fortification of different additives maintaining its quality and nutritional values.

CO3- Study the processing and milling of wheat, rice maize which will promote gainful employment..

CO4- Students will also become familiar with hygienic and safe handling of Cereal Products.

Paper Code FT 301 Max. Marks : 25 Credits : 1

7. Milling of wheat. Evaluation of properties of wheat and milled products
8. Physical, chemical and rheological.
9. Baking of bread, biscuit, cake, pastries. - Evaluation of baked bread. –
10. Evaluation of properties of rice (physical and chemical). - Cooking quality of rice. - Experiment on parboiling, evaluation of quality. - Milling of rice, assessment of degree of polishing.
11. Milling of pulses. –
12. Visit to flour mill, rice mill and pulse mill industries.

Title	**PROCESSING OF FRUITS & VEGETABLES**			**Credits**	04
Code	FT 302	**Semester:-**5th		**L T P**	3 - 2
Max.Marks	**End term- 40**	**Mid term- 35**	**Practical -- 25**	**Elective**	N
Pre requisites				**Contact Hours**	42 (Theory) 14 (Practical Sessions)

Course Objectives

CO1: The students will gain knowledge about various techniques employed by food industries to preserve the raw material.
CO2: The students will gain knowledge about how to increase its shelf life by tackling various physical, chemical and biological constraints.
CO3: The students will gain knowledge about various techniques employed by food industries to preserve the finished constraints.
CO4: Students will get familiar with by-product utilization process of fruits and vegetable industry.

Course outcomes

The students will gain knowledge about various techniques employed by food industries to preserve the raw material and finished products and to increase its shelf life by tackling various physical, chemical and biological constraints. Students will get familiar with by-product utilization process of fruits and vegetable industry.

THEORY		**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.		
SECTION- A			
Physiology of ripening. Effect of physical and chemical treatments on post harvest life of fruits and vegetables. Role of plant growth regulators in post harvest storage, Storage and handling of fresh fruits and vegetables. Preservation of fruits and vegetables by heat treatment, Canning Processing and preservation of fruits and vegetable juices. Preparation of jams, jelly, marmalade, preserves, pickles and vegetable products.			
SECTION- B			
Fermented fruit and vegetable products. Freezing and dehydration of fruits and vegetables. Concentration of fruits and vegetable juice. Effects of processing on the nutritive value of fruits and vegetables. Food additives, Fermented foods, pickling and curing of food. Intermediate moisture foods, by product and their utilization. Application of enzymes in processing of fruit and vegetable juices. Design of cleaning, cutting, blanching, and thermal processing equipments. Plant layout.			

***Books Recommended*:**

1. Giridhari Lal :. 4. : Preservation of Fruits & Vegetables, ICAR Publication, India.
2. Ranganna : : Analysis of Fruits land Vegetables, Tata MacGraw Hill, India.
3. Luh & Woodroof : : Commercial Vegetable Processing, AVI Publishing, USA
4. Woodroof & Luh : : Commercial Fruit Processing, AVI Publishing, USA Bhatt, V. I. & Vora, S. M.

Paper Title : FRUITS & VEGETABLES PROCESSING LAB (Practical)

CO1. The students will gain knowledge about the manufacturing technology of Fruits and vegetable products.

CO2. Understand the importance of various ingredients required for preparation of products and calculate the quantity requirement of each constituent.

CO3. Prepare fruit and vegetable products of desired specification.

CO4. Enumerate the processing and preservation of fruits and vegetables by heat treatment and understand the dehydration methods used for drying fruit and vegetables.

Paper Code FT 302 Max. Marks : 25 Credits : 1.

1. Blanching of fruits and vegetables: Effect of temperature, time and selected compounds on blanching. 2. Preparation of fruit juices. Squashes, R- T -S, nectar.
3. Preparation of jam, marmalade preserve, candy.
4. Preparation of fruit juice concentrate and powder.
5. Preparation of tomato products.
6. Preparation of pickles, chutneys, sauces.
7. Drying of fruits & vegetables. 8. Freezing of fruits & vegetables.
9. Quality control of processed products.
10. Can seaming operation and canning of fruits and vegetables.
1. Visit to a fruit and vegetable processing plant.

Title	**BEVERAGE TECHNOLOGY**			**Credits**	03
Code	FT 303	**Semester:-**5th		**L T P**	3 - -
Max. Marks	**End term- 50**	**Mid term-50**	**Practical-25**	**Elective**	N
Pre requisites				**Contact Hours**	42 (Theory) 14 (Practical Sessions)
THEORY				**Time**	3 Hours
Course Objectives	1. *Students will learn about various types of beverages, their role in health, and the fermentation processes involved in making beverage.* 2. *It will enable students to learn about the procedures and machinery involved in the manufacture of beverages.*				
Course Outcomes	CO1 Recognize the types of beverages in market and understanding the processingtechniques and safety aspects of drinking water. CO2 Understand the technology of non-alcoholic beverages along with the importance and effect of quality of raw materials on the final products. CO3 Understand the principle behind the production of various alcoholic beverages and importance of every step for a safe and effective production. CO4 Learn the process and machinery involved in production of beverages that will be help in designing and creating newer processes and products that are better economically, nutritionally or technologically.				
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
SECTION- A					
Status of the beverage industry in India. Its future prospects. Technology of manufacture of mineral water. Technology of manufacture of non-alcoholic beverages: fruits & vegetable juices, soft drinks, dairy beverages, etc.					
SECTION- B					
Technology of manufacture of alcoholic beverages: Beer, wine, whiskey, rum etc. Technology of					

manufacture of tea and coffee drinks. Design of equipments used in manufacturing of beverages. Plant layout.

Books Recommended:

1. Woordroof & Phillips : : Beverages, AVI Publication, USA
2. Wangham, D.A. : Coffee & Tea, Interscience Publication, USA.
3. Ranganna : Handbook of Analysis of Fruit and Vegetable Products.

Title	**CONFECTIONARY TECHNOLOGY**			**Credits**	03
Code	FT 304		**Semester:-**5th	**L T P**	3 - -
Max. Marks	**End term- 40**	**Mid term-35**	**Practical-25**	**Elective**	N
Pre requisites				**Contact Hours**	42 (Theory)

Course outcome

CO1: Students will be able to implement their knowledge in diverse confectionary manufacturing processes.

CO2: Students will be able to select suitable raw material, optimize proess conditions and maintain the quality of the product.

CO3: Students will be able to choose suitable packaging material and also will be able to optimize the storage conditions for confectionary products..

THEORY		**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.		
SECTION- A			
Types of confectionary goods. Characteristics and processing of raw materials. Technology of manufacture of toffee, chocolate, fruit drops, hard-boiled candies, bars, chewing gums, bubble gums and special confectionary goods.			
SECTION- B			
Color, flavor and texture of confectionery. Standards and regulations. Economics and marketing of confectionery goods. Design of equipments used in confectionary. Plant layout.			

Books Recommended:

1. Beckette : : Industrial Chocolate Manufacture: 3rd Edition, CBS Publication, New Delhi, 2000
2. Marie : : : Handbook of Sweeteners, CBS Publication, New Delhi, 2000.

Paper Title : BEVERAGE & CONFECTIONARY Technology (Practical)

Paper Code FT 305 Max. Marks: 25 Credits : 1.

1. Water hardness, acidity, basicity, chlorination, total dissolved solids, chlorides, iron, phosphorus in water.
2. Determination of alcoholic content in beer and wine using the distillation method. 47
3. Sulphur dioxide content in juices, squash, wine etc.
4. Acidity and total soluble solids determination in different beverages.

5. Manufacture of whey.
6. Estimation of caffeine in tea and coffee.
7. Determination of extract in tea leaves.
8. Sensory evaluation techniques and their uses.
9. Manufacture of milk based beverages (fermented and un-fermented).
10. Experiments on preparation of confectionary goods.

Paper Title: PROCESS PLANT DESIGN -I (Practical)

CO1: Design and specifications of pipes, pumps, fans and blowers.
CO2: Design and specifications Dor thickeners, dust chambers, cyclone separators and centrifuges.
CO3: Design of agitated vessels, impellers and Conveyor system for solids.

Paper Code CHE 306 **Max. Marks : 25** **Credits : 1.**

1. Design of piping & piping networks.
2. Selection, specification & power requirements of process pumps, fans and blowers.
3. Design of settling equipment like Dor thickners, dust chambers, cyclone separator & centrifuges.
4. Design of agitated vessels using various types of impellers.
5. Design of conveyor system for solids.

Books Recommended

1. Luding, E.E. : Applied Process Design in Chemical in Petrochemical Plants, Gulf Publishing Company.
2. Perry, J.H. : : Chemical Engineering Handbook, McGraw Hill.
3. Joshi, M.V Process Equipment Design, Macmillan Indian.
4. Peters, M.S. and Timmerhaus, K.D. Plant Design and Economics for chemical Engineers, McGrawHill.

SIXTH SEMESTER

Title	**Numerical Methods in Chemical Engineering**			**Credits**	04
Code	**CHE 301**	**Semester:-**6th		**L T P**	3 1 -
Max.Marks	**End term- 50**	**Mid term- 50**		**Elective**	N
Pre requisites				**Contact Hours**	42
THEORY			**Time**		3 Hours
Course Objectives	1. To learn evaluate error in calculations and find numerical solution of algebraic and transcendental equations. 2. Understand the concept of Finite Differences and Learn to use Interpolation and Inverse Interpolation with equispaced and unequispaced data. Learn to use Least Square Curve Fitting Procedure. 3. Learn the methods to carry out numerical differentiation and numerical integration. 4. Learn to solve linear system of equations by Direct and Iterative methods. 5. Learn to solve ordinary differential equations of First and Higher order numerically using various methods. 6. Learn to use Finite Difference Approximation method to solve partial differential equations numerically.				
Course Outcomes	CO1: Learn evaluating error in calculations, use of numerical methods for solving algebraic and transcendental equations and using various methods to carry out numerical differentiation and numerical integration. CO2: Understanding the concept of Finite Differences and Learn to use this for Interpolation and Inverse Interpolation with equispaced and unequispaced data. Learn to use Least Square Curve Fitting Procedure. CO3: Solve numerically ordinary differential equations of First and Higher order/Simultaneous differential equations using different methods. CO4: To Find the solution of linear system of equations by Direct and Iterative methods. Learn to solve partial differential equations using Finite difference approximation method.				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
SECTION- A					
Errors in Numerical Calculations, Solution of Algebratic and Transcendental Equations: The Bisection Method, The method of False Position, The Iteration Method, Newton-Raphson Method. Interpolation: Finite Differences, Differences of a Polynomial, Newton's Formulae for Interpolation, Central Difference Interpolation Formulae, Interpolation with Unevenly Spaced Points, Divided Differences and their Properties, Inverse Interpolation, Curve Fitting, Least-Squares Curve Fitting Procedures.					
SECTION- B					
Solution of Linear Systems, Gaussian Elimination Method, Gauss-Jordan Method, Jacobi Iteration Method, Gauss-Seidel Iteration Method. Numerical Differentiation and Integration: Trapezoidal Rule, Simpson's 1/3 –Rule, Simpson's 3/8-Rule, Weddle's Rules and Romberg Integration. Numerical Solution of Ordinary Differential Equation: Taylor's Series Expansion Method, Picard's Method, Euler's Method, Runga-Kutta Methods, Predictor-Corrector Methods, Simultaneous and Higher Order Equations					

***Books Recommended*:**

1. Hildebrand, F.B. : Introduction to Numerical Analysis.
2. Scarborough, J.B. : Numerical Mathematical Analysis, Oxford and ISH Pub. Co.
3. Chopra, S.C., & Canale, R.P. Numerical Methods for Engineers.
4. Sastry, S. S. Introductory Methods of Numerical Analysis, 4th Edition, Prentice Hall

Title	Mass Transfer-II			Credits	05
Code	CHE 309	Semester:-6rd		L T P	3 1 3
Max. Marks	End term-50	Mid term-50	Practical- -25	Elective	N
Pre requisites				Contact Hours	42 (Theory) 14 (Practical Sessions)

THEORY	Time	3 Hours
Course Objective	The course objective is to study the concepts of mass transfer equilibria and operating lines for various systems like vapour-liquid, liquid-liquid, solid liquid and solid-gas systems, liquid - liquid extraction, leaching, adsorption and to apply the concepts to real problems.	
Course Outcomes	CO1: To understand the concepts of mass transfer equilibria for vapour-liquid and to generate operating line for various mass transfer systems like absorption, distillation, liquid-liquid extraction. Leaching, adsorption and principles of crystallization. CO2: The students are able to comprehend the concepts of co current & counter current processes, cascades and concept of Ideal stage and stage efficiencies, continuous contact equipments, number of transfer units and height of a transfer unit (NTU & HTU) concepts, packed column for absorption, equipment for gas absorption CO3: The students will get acquaintance about McCabe–Thiele methods & Ponchon Savarit method to calculate the number of stages for distillation column and able to design the column.	
Note for the Examiner	The semester question paper of the subject will be of 40 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.	

SECTION- A

Absorption: Equilibria for absorption systems – use of Raoult's law, Henry's law for solubility predictions, Selection of absorbent, limiting liquid gas ratios, absorption factor use in design of plate absorbers. Kremser equation for ideal plates and translation of ideal plates to real plates using various efficiencies. Concept of transfer units for the design of packed absorbers. Distillation: Limitations and applications, prediction of VLE using thermodynamic & experimental techniques. Dew point & bubble point estimations for binary & multicomponent mixtures. Distillation methods – flash distillation, differential distillation for binary systems, steam distillation, optimum reflux ratio. Fractionation of binary mixtures using McCabe – Thiele method and enthalpy concentration method (Ponchon and Savarit method). Packed distillation columns. Azeotropic & extractive distillation preliminaries and molecular distillation.

SECTION- B

Liquid-Liquid Extraction: Ternary Equilibria and its representation on various plots. Selection criteria for solvent, Multistage extraction using partially miscible & immiscible solvents. Stagewise contact for countercurrent and crosscurrent extraction. Constructional details of equipment like mixer-settler, packed columns, pulsed extractor, sieve-tray extractor and centrifugal extractor. Leaching: Preparation of solid, countercurrent and crosscurrent multistage contact Shank's system. Constructional details of equipment like Rotocel extractor, Hildebrandt extractor, Bollman extractor, Kennedy Extractor & Beet-Sugar Diffusion battery extractor. Adsorption: Types of adsorption, nature of adsorbents, equilibria for adsorption systems. Brief manufacture and commercial applications and characteristics for common adsorbents. Stagewise & continuous contacting of fluid and solid phase. Description of contact filtration adsorption system. Hypersorber Ion-exchange system. Crystallization:

Growth and properties of crystals saturation, nucleation, growth of crystals, effect of impurities on crystal formation, effect of temperature on solubility, fractional crystallization, yield of crystals, crystal purity, yield calculation using phase diagram, energy requirements using enthalpy-concentration diagram. Methods of creating super saturationMeirs supersolubility curve. Mechanism and methods for nucleation. Derivation for ideal growth of crystals and discussion of actual growth. Swanson-Walker and various vacuum crystallizers.

Book Recommended

1. 1. Treybal, Robert E. : 4. 5. : Mass Transfer Operations, 3rd Edition. McGraw-Hill, 1981.
2. Sherwood, T.K., Pifford, Robert L. and Wilke, Charles R. : Mass Transfer, McGraw-Hill.
3. Skelland, A.H.P : Diffusion Mass Transfer, John Wiley & Sons., New York, 1974.
4. McCabe, Warren L., Smith Juliam C. and Harriott, Peter : Unit Operations of Chemical Engg., 7th Edition, McGrawHill, 2005.
5. King, C.J. : Separation Processes, Tata McGraw Hill Publishing Co. Ltd., New Delhi , 1982.
6. Geankoplis, C.J : Transport Process and Separation Processes, 4th Edition, Prentice Hall Inc., New Delhi, 2003.

Paper Title : Mass Transfer II (Practical)

CO1: Application of different mass transfer equipments, Determination of mass transfer coefficients for naphthalene-air system. To determine drying rate curves for different wet solids in a batch drier.
CO2: Verification of Rayleigh's equation for differential distillation, Determination of flooding velocities in packed columns.
CO3: Determination of HETP for packed distillation columns, flooding velocities in packed columns.
CO4: Practice operation of a pilot sized distillation column under total reflux, Fractional approach to equilibrium for liquid-liquid extraction from single drop.
CO1: Application of different mass transfer equipments, Determination of mass transfer coefficients for naphthalene-air system. To determine drying rate curves for different wet solids in a batch drier.
CO2: Verification of Rayleigh's equation for differential distillation, Determination of flooding velocities in packed columns.
CO3: Determination of HETP for packed distillation columns, flooding velocities in packed columns.
CO4: Practice operation of a pilot sized distillation column under total reflux, Fractional approach to equilibrium for liquid-liquid extraction from single drop.

No. of Practicals: 08

Paper Code CHE 309 Max. Marks : 25 Credits : 1

1. Determination of mass transfer coefficients for naphthalene-air system.
2. To determine drying rate curves for different wet solids in a batch drier under constant drying conditions
3. Fractional approach to equilibrium for liquid-liquid extraction from single drop.
4. Verification of Rayleigh's equation for differential distillation.
5. Determination of flooding velocities in packed columns.
6. Determination of HETP for packed distillation columns.
7. Study and operation of a pilot sized distillation column under total reflux.

8. Study of different mass transfer equipments.

Title	**CHEMICAL REACTION ENGINEERING I**			**Credits**	05
Code	**CHE 303**	**Semester:-**3rd		**L T P**	3 1 3
Max.Marks	**End term- 50**	**Mid term- 50**	**Practical --25**	**Elective**	N
Pre requisites				**Contact Hours**	42
THEORY				**Time**	3 Hours
Course Objective	The course aims to understand the basic concepts of chemical kinetics for different types of reactions. Design of the reactors for homogeneous reactions such as batch, plug-flow and mixed-flow reactors. To understand the effect of temperature and pressure on reaction kinetics. The students learn about the real reactor on understanding the reasons of non-ideality in ideal reactors.				
Course Outcomes	CO1: To understand the mechanism of chemical kinetics for different types of reactions. CO2: To design batch and flow reactors for single homogeneous reactions. CO3: To understand the factors affecting the conversion, yield and selectivity in multiple reactions. CO4: To understand the concepts of non-ideal reaction.				
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.				
SECTION- A					
Introduction and a brief review of the kinetics of homogeneous reactions. Interpretation of rate data from constant volume and constant pressure systems. Single Ideal reactors. Design for single reactions.					
SECTION- B					
Design for multiple reactions. Thermal characteristics of reactors: temperature and pressure effects. Non-ideality in reactors and its effects on chemical conversion. One parameter models to represent the behaviour of chemical reactors.					

***Books Recommended*:**

1. Levenspiel, O. : Chemical Reaction Engineering, 3rd Edition, John Wiley and Sons, 2004.
2. Smith, J.M. : Chemical Engineering, Kinetics, 3rd Edition, and McGraw Hill, 1981.
3. Dinbigh, K. & Turner, K.G. Chemical Reactor Theory – An Introduction, Cambridge Univ. Press.
4. Scott Fogler, H. Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall, 2007.

Paper Title : REACTION ENGINEERING LAB. (Practical)

CO1: Describe the kinetics of a batch and semi batch and adiabatic batch reactor
CO2: To understand and demonstrate kinetics of CSTR and PFR
CO3: Perform RTD studies in a CSTR

No. of Practicals: 08

Paper Code CHE 303 **Max. Marks 50** **Credits : 1**

1. Kinetic studies in a batch reactor.
2. Kinetic studies in a plug flow reactor.

3. Kinetic studies in a CSTR.
4. Kinetic studies in a semi batch reactor.
5. RTD studies in CSTR.
6. Dispersion number for packed bed reactor.
7. Adiabatic batch reactor.

Title	**Processing of Oil Seeds, Oils and Fats**			**Credits**	04
Code	FT 306	**Semester:-**6th		**L T P**	3 - 2
Max. Marks	**End term-40**	**Mid term-35**	**Practical-25**	**Elective**	N
Pre requisites				**Contact Hours**	42 (Theory) 14 (Practical Sessions)

Course outcome

CO1: Students will be able to implement their knowledge in choosing proper extraction process and
CO2: Students will be able to optimization of process parameter of oil from diverse oil bearing material.
CO3: Will also be able to optimize refining and storage conditions of oils and fats without rancidity development.
CO4: Students will also be able to optimize by product utilization and manufacturing of valuable products out of that.

THEORY	**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.	
SECTION- A		
Status of oils & fats and Indian economy. General chemistry. Analytical methods for characterization. Quality standards of edible oils & fats in diet, nutrition & disease. Detection of adulteration. Oil milling methods: Ghani, mechanical expeller, hydraulic press, solvent extraction. Refining of edible oils & fats. Basic processing of fats and oils - oil extraction, degumming, refining, bleaching, hydrogenation, fractional crystalization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering. Chemical adjuncts-lecithins, monoglycerides and derivatives, propylene glycol esters, polyglycoesters.		
SECTION- B		
Classification of vegetable oil. Modifications of the properties of oils & fats including chemical and biotechnological processes. Confectionary plastic fats. Preparation of various products including different shortenings, margarine, salad dressing & mayonnaise, imitation of dairy products low calorie spreads. Animal fat, oil derivatives. Technology of oilseed protein isolate. Utilization of byproducts from the oil milling industry. Design of oil milling equipments and plant layout.		

***Books Recommended*:**

1. Bailey : Fats and Oil, Wiley, USA.
2. Solomons, T. W. G. : Fundamentals of Organic Chemistry, John Wiley and Sons, Inc., New York, 1994
3 Salunkhe, O.K. Chavan, J.K, Adsule, : World Oilseeds: chemistry, Technology and Utilization. VNR, New York, 1992

R.N. and Kadam, S.S.
4 Wolf, I.A. : Handbook of Processing and Utilization in Agriculture. CRC Press, Florida, Ed. 1983 (2 vol set)
5 Hamilton, R.J. and Bharti, A. : Fats and Oils: Chemistry and Technology. Applied Science, London. Ed. 1980.

Title	**Processing of Milk and Milk Products**			**Credits**	**04**
Code	**FT 307**		**Semester:-6th**	**L T P**	**3 - 2**
Max. Marks	**End term-40**	**Mid term-35**	**Practical-25**	**Elective**	**N**
Pre requisites				**Contact Hours**	42 Theory) 14 (Practical Sessions)

Course outcome

CO1: Students will be able to implement their knowledge in milk procurement, processing and packaging.
CO2: Students will be able to implement their knowledge in optimization of development of milk products.
CO3: Students will be able to detect adulterant present in the milk and milk products.
CO4: Students will be able to implement their knowledge in dairy equipment design and optimization of process variable of milk processing.

THEORY		**Time**	3 Hours
Note for the Examiner	The semester question paper of the subject will be of 50 marks having 8 questions of equal marks. The paper will be divided into two parts having four questions each from Section A and Section B. The candidate is required to attempt total 5 questions selecting atleast two questions from each Section.		

SECTION- A

Present status of milk & milk products in India and Abroad; market milkComposition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.

Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder.

Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter.

SECTION- B

Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture.

Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.

Indigenous milk products - Present status, method of manufacture of yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi etc; probiotic milk products. Practical Study on basics of reception of milk at the plant; platform tests in milk; estimation and fat and SNF in milk; Operation of LTLT & HTST Pasteurization; Preparation of special milks; Cream separation & standardization of milk; Preparation and evaluation of table butter, icecream, cheese and indigenous milk product such as khoa, chhana, paneer, ghee, rosogolla, gulab jamun, shrikhand, lassi, burfi etc.; Visit to dairy plants.

***Books Recommended*:**

1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. : Technology of Indian Milk Products. Dairy India Publ. 2002.
2. De S. : Outlines of Dairy Technology. Oxford Univ. Press. 1980.
3 Henderson JL. : 1971. Fluid Milk Industry. AVI Publ.
4 Spreer E. : 1993. Milk and Dairy Products. Marcel Dekker.
5 Walstra P. 1999 : Dairy Technology. Marcel Dekker, 1999

Paper Title : Processing of Milk and Milk Products (Practical)
No. of Practicals: 08

CO1: Students will be able to implement their knowledge in milk Industry during processing, packaging and optimization of pasteurization conditions,
CO2: Students will be able to implement the knowledge in making milk concentrate, milk powder and icecream.
CO3: Student will be able to implement their knowledge in dairy equipment design and optimization of process variables of milk processing.
CO4: Students also will be able to apply their knowledge in detecting adulterant present in the milk and milk products.

Paper Code FT 307 Max. Marks : 25 Credits : 1

1. Physical and chemical analysis of milk & milk products.
2. Testing the adulteration in milk & milk products.
3. Preparation of cream, butter, ghee, ice-cream, milk powder and condensed milk.
4. Quality evaluation of milk products.

Title	**Chemical Engineering Computation Lab**			**Credits**	**01**
Code	**CHE 307**	**Semester:-6th**		**L T P**	**- - 3**
Max. Marks	**End term-**	**Mid term-**	**Practical-25**	**Elective**	**N**
Pre requisites				**Contact Hours**	14 (Practical Sessions)

CO1: Determination of solution of linear and non-linear algebraic and transcendental equations using computer programs or MATLAB.
CO2: To carryout Numerical differentiation & integration using computer programs.
CO3: To find solution of Ordinary and partial differential equations using computer programs.
CO4: Carryout Interpolation and least squares approximation using computer programs.

1. Errors analysis, solution of linear and non-linear algebric equations.
2. Numerical differential & integration. Interpolation.
3. Least squares approximation. Ordinary and partial differential equations.
4. Development of computer programs based on the above topics using Matlab and their applications in chemical process computations.

Books Recommended:

1. Grewal, B.S. : Numerical Methods in Engineering and Science, Khanna Publishers, N. Delhi, 2001.
2. Sastry, S.S. : Introductory Methods of Numerical Analysis, Prentice Hall of India.

Title	**Process Plant Design-II Lab**			**Credits**	01
Code	**CHE 405**	**Semester:-6th**		**L T P**	- - 3
Max.Marks	**End term**	**Mid term**	**Practical:25**	**Elective**	N
Pre requisites	**-**			**Contact Hours**	14 (Practical Sessions)

CO1: Design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condenser and reboiler.
CO2: Design of distillation column, calculation of number of plates, height and design of fractionator internals- sieve tray.
CO3: Design aspects of fixed bed reactors and fluidized bed reactors.

Practical

1. Process design and specifications of double pipe heat exchanger, shell and tube heat exchanger, plate type heat exchanger, condenser and reboiler.
2. Design of distillation column, calculation of number of plates, height and design of fractionator internals- sieve tray.
3. Absorber/Stripper design of stage-wise and continuous contact equipment (packed column), height of column and diameter calculations. HTU and NTU.
4. Design aspects of fixed bed reactors and fluidized bed reactors.

***Books Recommended*:**

1. Coulson, Richardson & Sinnott, R.K. : Chemical Engineering, Volume 6 – An Introduction to Ch Engineering Design, 4th Edition, Pergamon Press, 2007.
2. Ludwig, E.E. : Applied Process Design in Chemical and Petrochemical 2nd Edition, 1977.
3. Perry, J.H. : Chemical Engineers Handbook, 8th Edition, McGraw Hill,
4. Kern, D.Q. : Process Heat Transfer, McGraw Hill, 1965.
5. Shell and Tube Type Heat Exchangers, Indian Standards. : Instt., IS: 43-197.
6. Treybal, Robert E. : Mass Transfer Operations, 3rd Edition, McGra 1981.
7. Levenspiel, O. : Chemical Reaction Engineering, 3rd Edition, Joh Wiley and Sons, 2004.

8.	Walas, S.M.	:	Reaction Kinetics for Chemical Engg., McGraw Hill.
9.	Scott Fogler, H.	:	Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall, 2007.

Seventh Semester

Title	**PROCESS DYNAMICS & CONTROL**			**Credits**	5
Code	CHE 310	**Semester:-**7th		**L T P**	3 1 3
Max.Marks	**End term 50**	**Mid term 50**	**Practical : 25**	**Elective**	N
Pre requisites	**-**			**Contact Hours**	42 (Theory) 14(Practical Sessions)

THEORY

Course Objective	The objective of the course is focused to make the students understand the fundamental aspects of control systems employed in various chemical process industries along with the challenges and development of dynamic models of various processes through Laplace transformations.
Course Outcomes	CO1 Describe need of chemical process control & design aspects of a process control system. Laplace transform and transfer functions. Difference between lumped and distributed parameter system. CO2 Define dynamic behaviour of first and higher order systems. Different modes of control actions and their basic characteristics, controllers and their characteristics, control valves CO3 Describe closed loop transfer functions, transient response of simple control systems, Routh stability criterion, Root locus. Introduction to frequency response CO4 Describe and apply advanced control techniques such as cascade control, feed forward control, ratio control, inferential control
Note for the Examiner	**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

SECTION- A

Incentives for chemical process control, design aspects of a process control system. Difference between feedback and feed forward control configuration. Hardware elements of a control system, Block Diagrams.

Laplace transform and transfer functions. Difference between lumped and distributed parameter systems, Dynamic behaviour of first and higher order systems, interacting and non-interacting systems, dead time.

Different modes of control actions and their basic characteristics, controllers and their characteristics, control valve.

SECTION- B

Closed-loop transfer functions, transient response of simple control systems, Routh stability criterion, Root Locus.

Introduction to frequency response: Bode diagrams, control system design by frequency response: Ziegler-Nichols controller settings, stability using frequency response, gain margin and phase margin.

Introduction to advanced control techniques such as cascade control, feed forward control, ratio control, inferential control.

Practicals

CO1: To plot the response curve for a given input to a U-tube manometer and to determine the transfer function from the response

CO2: To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value.
CO3: Determine Experimentally characteristics of of control valves and liquid level measurement systems.
CO4: Experimental studies on temperature and pressure control systems.

1. U-Tube manometer
   (a) To plot the response curve for a given input to a U-tube manometer.
   (b) To determine the transfer function from the response curve obtained in part (a).
2. Time constant of a mercury thermometer
   To study the dynamics of the given thermometer and compare the theoretical value of its time constant with the experimental value.
3. Analysis of valve
   Develop a block diagram representing the dynamic bahavoiur of the given globe valve.
4. (a) Liquid level measurement
   With the given Bubbler System for Liquid Level Measurement, evaluate liquid height in the tank and compare it with actual values.
   (b) Calibration of Pressure Gauge
   Calibrate a pressure gauge in the range 0 psi to 60 psi.
5. Temperature control system
   To maintain the temperature of the fluid at the set point value.
6. Time constant of liquid level tank
   To study the dynamics of liquid level in a tank and compare the analytical value of the time constant with the experimental value.
7. Liquid level control
   (a) To carry out the closed loop experiment on the given liquid level control system and record its response for step change in the inlet flow.
   (b) To plot the experimental response curve and comment on the response obtained.
8. Compurec
   Pressure control simulation with step input and sinusoidal input.

Recommended Books

1. Coughanowr, D.R. : Process Systems Analysis and Control, 2nd Edition. Mc Graw Hill, 1991.
2. Stephanopolous G. : Chemical Process Control -An Introduction to Theory and Practice, Prentice Hall of India, New Delhi, 2008.
3. Luyben W. L. and Luyben M.L.: Essentials of Process control, Mc Graw Hill International Editions, 1997.
4. Ogata K.: System Dynamics, 4th Edition, Pearson Education, 2004.
5. Harriott, P. : Process Control, TMH Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1972.

Title	**Process Engineering Economics**			**Credits**	4
Code	CHE 408	**Semester:-7th**		**L T P**	3 1 -
Max.Marks	**End term 50**	**Mid term 50**	**Practical**	**Elective**	N
Pre requisites	**-**			**Contact Hours**	42
THEORY					
Course Objectives	The objective of the course is to expose students to basic concepts in				

	engineering economics, plant design, safety features and its importance to chemical engineering. The course isolates those problems that are commonly faced by engineers and develops the tools to properly grasp, analyse, and solve them. The tools introduced include present worth analysis, annual cash flow, rate of return, incremental analysis, future worth analysis, and payback period. The course also covers such topics as depreciation, after tax analysis, replacement analysis, inflation, and deflation.
Course Outcomes	CO1: Formulate and apply interest factors to real life engineering problems CO2: Perform economic analysis for process to calculate equipment cost CO3: Develop and apply mathematical models describing real life cash flows and time value of money CO4: Evaluate engineering alternatives and profitability for process CO5: Perform breakeven analysis and optimum and plant design of a process.
Note for the Examiner	**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

SECTION-A

Cost estimation: Factors affecting investment and production costs. Capital investments, fixed investments and working capital. Cost indices. Estimating equipment costs by scaling 6/10 factor rule. Methods for estimating capital investment. Estimation of total product cost. Different costs involved in the total product costs. Different cost involved in the total product for a typical chemical process plant.

Interest and Investment Costs: Simple and compound interest. Nominal and effective rates of interest. Continuous interest ordinary annuity. Perpetuities and capitalized costs.

Taxes and Insurance: Types of taxes and tax returns, types of insurance and legal responsibility.

Depreciation: Types of depreciation. service life salvage value, present value and methods of determining depreciation, single unit and group depreciation.

SECTION-B

Profitability, Alternative Investments and Replacements: Mathematical methods of profitability evaluation. Cash flow diagrams. Determination of acceptable investments. Alternatives when 'an investment must be made and analysis with small increment investment, replacement. Breakeven analysis. Balance sheet and income statement.

Optimum Design: Procedure with one variable, optimum reflux ratio in distillation and other examples.

Preliminary Steps in Plant Design: Plant design factors. project organization, plant location, preliminary data collection, process engineering

***Books Recommended*:**

1. Peters, M.S. & Timmerhaus, K.D. : Plant Design and Economics of Chemical Engineers, Mc Graw H New York, 4th Edition, 1991.
2. Ulrich, G.D. : A Guide to Chemical Engineering Process Design & Economics, Jo Wiley, 1984.
3. Guthrie, K.M. : Process Plant Estimating, Evaluation & Control, Craftsman Sola Beach, Calif, 1947.
4. Jelen, F.C. : Cost and Optimisation Engineering, McGraw Hill, New York, 1970.
5. Holland, F.A. & Wastson, F.A. : Introduction to Process Economics, 2nd Edition, Wiley, 1983.
6. Bassel, W.D. Preliminary Chemical Engineering Plant Design, Elsevier, New Yo 1976.

Title	**Literature Survey, Report Writing & Seminar**			**Credits**	No credit
Code	CHE 410		**Semester:-**7th	**L T P**	- - 3
Max.Marks	**End term**	**Mid term**	**Practical: s or x**	**Elective**	N
Pre requisites	**-**			**Contact Hours**	14 (Practical Sessions)
Course Objectives	➢ To gain an understanding of the existing research relevant to a particular topic or area of study and define the problem statement ➢ Critical analysis of the published work and develop arguments to support the published work with evidence ➢ To present that knowledge in the form of a presentation and written report.				
Course Outcomes	CO1: Survey of scientific, technical and commercial literature in engineering/technology and defining problem statement. CO2: Critical analysis and evaluation of literature CO3: Demonstrate effective public speaking and impromptu discussions CO4: Write technical report in a coherent and concise manner.				

Practicals

Forms of technical reports: aims and forms according to type of readership and extent of circulation. Abstracts, extended abstracts, tables, graphs. Visual representation of data: slides, microfilms, others techniques including those of audio-visual representation. Correct use of audio equipment.

Research papers and their presentation and publication. Information retrieve direct and through abstracts.

Practical training in writing and presentation of technical reports through audio-visual means. Technique of effective public speaking organized and imprompt discussions.

Preparation of technical report on an assigned topic after survey of scientific, technical and commercial literature, using card indexes, microfilms and other information retrieval methods.

Use of Computer softwares for report writing.

***Books Recommended*:**

1. Mikdran, A.M. : Use of Engineering Literature, Butter Worths.
2. Sottle, R.T. : The Use of Chemical Literature, Butter Worths.
3. Hoover, H. : Essentials For TheTechnical Writer, John Wiley.
4. Robertson, W.S. & Siddle, W.D. : Technical Writing and Presentation, Pergamon.

Eight Semester

Title	**Environmental Engineering**			**Credits**	5
Code	CHE 402	**Semester:-**8th		**L T P**	3 1 3
Max.Marks	**End term 50**	**Mid term 50**	**Practical: 25**	**Elective**	N
Pre requisites	**-**			**Contact Hours**	42 (Theory) 14 (Practical Sessions)

THEORY

Course Objectives	1. This course aims at developing the students about environmental impacts of air, water and solid pollution. 2. The course aims at giving the students an insight into the environmental issues related to chemical process industries in terms of their impact on land, water and air and the possible mitigation techniques to reduce this effect for sustainably. 3. This course also aims to develop the basic knowledge about the biomedical, hazardous, and waste management.
Course Outcomes	CO1: Describe principal air pollutants, their sources and effects. CO2: Discuss atmospheric dispersion of air pollutants and estimate concentration of air pollutants. CO3: Demonstrate the construction, working and theory of equipments used for the control of air pollution. CO4: Classify water pollutants, their sources and effects and calculation of water quality parameters. CO5: Application and design of physical/ chemical/ biological treatment methods for small communities/municipal sewage/industrial water/ waste water treatment. CO6: Classify solid wastes, their sources, effects and methods of disposal of solid wastes.
Note for the Examiner	**Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.**

SECTION-A

Ambient air and water standards. Principal sources of pollution.

Inter-relationship between energy and environment pollution. Prevention of environmental pollution through conservation, raw material substitutions, process and equipment modifications. A case study on the concept of zero discharge.

Air Pollution:

- Principal air pollutants and their usual sources.
- Effect of air pollutants on human health, animals, vegetation and materials.
- Atmospheric dispersion of air pollutants, temperature inversions, Estimation of pollutants by Gaussian plume model.
- Process and equipments used for the control of particulate pollutants.

SECTION-B

Water Pollution:

- Types of water pollutants, their sources and effects.
- BOD and COD
- Waste water treatment techniques and equipments, flocculation, skimming, floatation, etc.
- Primary Treatment-through settling.
- Secondary Treatment-Aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

Solid wastes: Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling.

***Books Recommended*:**

1. Perkins, H.C. : Air Pollution, McGraw Hill, N.Y.
2. Rao, C.S. : Environmental Pollution Control Engineering, 2nd Edition, New International Pvt. Ltd., 2006.
3. Williamson, S.J. : Fundamental of Air Pollution, Addison Wesley Co. N.Y.
4. Numerow, N.L. : Liquid Wastes of Industry, Addison Wesley Co., N.Y.
5. Sincero, A.P. and Sincero, G.A. : Environmental Engineering, Prentice-Hall of India, 1999.
6. Hammer, M.J. and Jr. Hammer, M.J. : Water and Wastewater Technology, 6th Edition, Prentice-Ha India, 2008.
7. Mahajan, S.P. : Pollution Control of Process Industries, Tata McGraw Hill.
8. Metcalf and Eddy : Waste-Water Engineering, 4th Edition, Tata McGraw Hill, 2007.

Environment Engineering Laboratory (PRACTICALS)

CO1: Calculate BOD, COD, TSS & TDS of wastewater samples.
CO2: Determination of chromium separation, phenol content of water sample & To find the biodegradation constant (K) and the effect of timing on it
CO3: Practice and apply electro dialysis apparatus and reverse osmosis set up for waste water analysis.
CO4: To use stack monitoring kit to find: Efficiency of a cyclone & Dust sampling.

1. To find BOD of water sample.
2. To find COD of waste sample.
3. To find the total dissolved solids (TDS) and its volatile and non-volatile components.
4. To find the total suspended solids (TSS) and its volatile and non-volatile components.
5. To do the chromium separation by different techniques from electroplating wastes.
6. To find the phenol content of water sample and evolution of parameters.
7. To operate the electrodialysis apparatus.
8. To find the biodegradation constant (K) and the effect of timing on it.
9. To use the membrane separation techniques for salt brine and reverse osmosis process for sugar.
10. To use stack monitoring kit to find:
    a. Efficiency of a cyclone.
    b. Dust sampling.

Note: Any six of the above mentioned experiments are to be conducted.

Paper Title : PROJECT WORK

CO1: Apply the knowledge of Food Technology and basic sciences to design or fabricate a system/unit/plant.
CO2: Apply knowledge to solve energy and material balance in Food Technology and design efficient process.
CO3: Analyze the process components and perform the cost analysis and efficiency of the process.

Paper Code FT 401

Each student is required to submit a project report on the design of a chemical plant, selecting the best process with optimum equipment size and operating conditions. The object is to test the ability of the student to apply his entire knowledge of Chemical Engineering principles to conceptualize, analyze and solve the problems. To judge his knowledge and originality and capacity for application of laboratory data in designing chemical plants and to determine the level of his proficiency at the end of the course.

Title	**Process Modelling & Simulation**		**Credits**	1
Code	CHE 403	**Semester:-**8th	**L T P**	- - 3

Max.Marks	End term	Mid term	Practical:25	Elective	N
Pre requisites	-			Contact Hours	14 (Practical Sessions)
Course Outcomes	CO1: Describe fundamentals of modelling and simulation, formulate mathematical models and perform degree of freedom analysis. CO2: Derive the mathematical models for chemical engineering systems and solve them using any one of the softwares Polymath/C/C++/Matlab. CO3: Apply simulation to get the output for the models of heat exchangers, distillation columns, reactor and process equipment.				

Practical

Functional design, property estimate as inputs for design. System concepts for computer aided design, computer aided flow sheet design. Process analysis. Process variables selection, equipment design through the selection of free parameters subject to constraints and other parameters, modular design. Simulation optimality. Dynamic design including control stability.

Typical equipments to be considered: heat exchangers, distillations columns, reactor and process equipments.

***Books Recommended*:**

1. Luyben, W.L. : Process Modeling, Simulation & Control, Mc Graw-Hill Book Co.
2. Franks, R.G. E. : Modeling and Simulation in Chemical Engineering, Wil Interscience.
3. Mischke, C. : Computer Aided Design, Prentice Hall.

Title	COMPREHENSIVE VIVA			Credits	01
Code	FT 404	Semester:-8th		L T P	- - -
Max. Marks	End term--25	Mid term- -	Practical-	Elective	N
Pre requisites				Contact Hours	

CO1: Demonstrate technical knowledge of theory and practical subjects taught during whole degree course.
CO2: Demonstration of professional aptitude, learning ability and communication skills, originality and capacity for application of this profession to service of mankind.
CO3: Strive for lifelong learning, exhibiting professionalism and ethical behaviour and service of the nation, discipline and society.

The viva-voce examinations will be comprehensive and covering mainly chemical engineering and technology subjects covered during all the semester including the Eight Semester.

Paper Title: Departmental Elective (Theory)

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

MEAT, FISH & POULTRY TECHNOLOGY (Theory)

CO1 Know the status of meat industry in India and study about structure of meat, nutritive value and shelf life of meat.

CO2 Provide an understanding of the technology for handling, processing, preservation and byproduct utilization of meat industry.

CO3 understanding the composition, structure of fish and poultry eggs and various techniques used for the preservation of eggs and fish.

CO4 understanding the concept of utilization of meat by-products and importance of hygiene and sanitation in meat industry.

SECTION-A

Development of meat and poultry industry in India. Ante-mortem examination of animals and poultry birds. Slaughter and dressing, post mortem examination. post-mortem changes, factors affecting them and their effect on shelf life of meat. Nutritive value of meat. Poultry dressing, wholesale and retail cuts. Communicated meat products. Canning of meat and meat products. Curing and smoking of meat. Meat tenderization. Disposal and utilization of meat industry by-products. MFPO. Sanitation of abattoir and meat processing. Modified atmospheric packaging of meats.

SECTION-B

Structure, composition and nutritive value of poultry eggs. Quality of eggs and its preservation. Egg Spoilage. Spray dried and frozen egg products.

Fish structure and composition, cold storage, freezing preservation and canning of fish. Pickling of fish, fish protein concentrates, fish meal and by-products of fish processing industry.

Sanitation in meat, fish, egg and poultry processing plants.

Books Recommended:

1. Henricksons, R.L : Meat, Poultry and Sea Food Technology, Prentice Hall.
2. Levie, Albert : Meat Hand Book, 4th Edition, AVI Publishing, Connecticut, 1984.
3. Mountney, G.J. and Poukhurst, C.R. : Poultry Products Technology, 3rd Edition, Food Products Press, 1995.
4. Borgstrom, George : Fish as Food (Vol. i, ii, iii, iv), Academic Press, New York, 1963.
5. Roberts, R.J. : Fish Technology.

PROCESSING OF MEAT, FISH & POULTRY (Practical)

Course Outcome

CO1: Students will be able to apply their knowledge in fish processing industry to optimize several fish preservation processes

CO2: Students will be able to implement their knowledge poultry processing industry to optimize several poultry preservation processes

CO3: Students will be able to apply their knowledge egg processing industry to optimize several egg preservation processes

CO4: Students will be able to implement their knowledge to maintain quality of meat, fish, poultry based processed product during storage.

(a) Fish & Meat: Cutting and handling.

(b) Dressing of poultry.

(c) Evaluation of quality of meat, fish & poultry.
(d) Canning, freezing, dehydration & curing of meat & fish.
(e) Quality of egg & egg powder, egg preservation.
(f) Preparation of pettie, emulsion etc.
(g) Visit to meat, fish & poultry processing industries.

PACKAGING TECHNOLOGY (Theory)

Course outcome

CO1: Students will be able to implement their knowledge in design of different packaging material.
CO2: Students will be able to implement their knowledge in size of pack and combination of different packaging material to make laminated pack.
CO3: Students will be able to implement their knowledge in labelling, printing of different packaged foods also able to design packaging machines.

SECTION-A

Basic concepts, function of food package, packaging materials, cellulosic, glass, metal, polymeric composite, rigid, semi-rigid and flexible package forms, adhesive, band and closure, coatings and labels, packaging, product characteristics and packaging requirements, selection of material, form, machinery and method of packaging, package printing, standards and regulations. Active Smart packaging and Edible packaging

SECTION-B

Special problems in packaging of foodstuffs. Biodegradable packaging.
Design of packaging equipments.
Evaluation of packaging materials for different food products and package performance.
Use of Nanocomposites in food packaging

Books Recommended:

1. Pines, F.A. : Fundamentals of Packaging, Cornhill Publication, London.
2. David, J.R. & David, D.R.D. : Aseptic Processing and Packaging & Food, CRC Press.
3. Sacharow & Griffin : Food Packaging, AVI Publishing, Westport, Conn.
4. Brody, A.L. : Flexible Packaging of Foods, CRC Cleveland, Ohio Press.
5. Heiss, R. : Principle of Food Packaging, An International Guide United Nations Food & Agricultural Organization, Rome, Italy, 1970.

BIOCHEMICAL ENGINEERING (Theory)

Course Objectives	1.	*To describe the major metabolic pathways involved in the metabolism of nutrients in the human body.*
	2.	*To help the students understand the basic principles of various biochemical processes and realize the importance of different design parameters in bioreactor operation.*
	3.	*To recognize the industrial implication of biochemical engineering.*
Course Outcomes	CO1	Gaining knowledge about metabolic pathways and cell growth.
	CO2	Understanding the concept of enzyme kinetics and their applications.
	CO3	Designing and creating new processes and fermented products that are better economically and technologically.
	CO4	Understanding the basic calculations for heat and mass transfer and yield of product.

SECTION-A

Isolation and Utilization of Enzymes: Purification, immobilization, application of enzyme technology.

Kinetics of Enzyme-Catalyzed Reactions: The substrate, enzyme kinetics, factors affecting enzymatic activity and enzymatic reactions in heterogeneous reactions.
Metabolic Pathways and Energetics of the Cell: The concept of energy coupling, aerobic and anaerobic metabolism, photosynthesis and biosynthesis, transport across cell membranes.
Cellular Genetics and Control: Growth and reproduction of a single cell, alteration of cellular DNA, commercial applications.

SECTION-B

Kinetics of Substrate Utilization. Product Yield and Biomass Production: Growth cycle for batch cultivation and its mathematical modeling, products synthesis kinetics, thermal death kinetics of cells and spores.
Transport Phenomena in Microbial Systems: Gas-liquid mass transfer, determination of oxygen transfer rates, mass transfer, surface-area correlations for mechanically agitated vessels, scaling of mass transfer equipment, particulate mass transfer, heat transfer.
Design and Analysis of Biological Reactors: The ideal continuous-flow stirred-tank reactor (CSTR), residence time distribution, different types of reactors, relationship between batch and continuous biological reactors. Fermentation technology, product manufacture by fermentation, reactors for biomass production.

***Books Recommended*:**

1. Balley & Ollis : Biochemical Engineering Fundamentals, McGraw Hill Book Co., 1986.
2. Aiba Humphrey & Millis : Biochemical Engineering, Academic Press, 1973.
3. Whitaker Stanbury & Whitaker, Hall : Principles of Fermentation Technology, Adita Books, New Delhi, 1997.

FOOD BIOTECHNOLOGY (Theory)

Course Objectives	1. *Understanding the basic concepts of food biotechnology along with principles of genetics in food industry.* 2. *Providing necessary skills required with application of biotechnology in development and progression of food technology.*
Course Outcomes	CO1 Learning fundamentals of food biotechnology and application of recombinant DNA technology in food processing industry. CO2 Knowledge of various fermentation techniques for the production of food and medicines. CO3 Learning production methods of organic acids, alcoholic beverages and glycerol and basic knowledge on genetic engineering and genetically modified crop CO4 Developing new products with improved quality and application of biotechnology for treatment of food industry wastes.

Section A

Introduction to food biotechnology, genetic engineering and its importance in food Technology. Advantages and disadvantages of genetically modified foods.

Technological aspects of industrial production fermented foods, beverages, vitamins, antibiotics, baker's yeast, single cell protein. Bio-colors, bio-flavors. Classification of fermentation. Application of fermentation technology in food preservation. Regulatory and social aspects of biotechnology of foods.

Section B

Production of alcohol, lactic acid and acetic acid from various food materials. Bacteriocin production and its use in food preservation. Biotechnological processes of manufacture of functional foods, nutraceuticals and probiotics. Biotechnological process for food fortification, prebiotics & oligosaccharides. Application of biotechnology in waste treatment of food industries. Improvement of quality of food by biotechnological processes. Biosensors.

Reference Books:

1. Daniel Charles. Lords of the Harvest: Biotech, Big Money, and the Future of Food (1st Edition). Perseus Books Group, 2001.
2. Adams, M.R. and M.O. Moss. Food Microbiology. Turpin Distribution Service Ltd., Blackhorse Road, Letchworth, Herts SG6 1HN, UK, 1995, 2nd edition.
3. Gauri Mittal.Food Biotechnology: Techniques and Applications. CRC Press, 1992.
4. Banwart, George J. Basic Food Microbiology, 2nd ed. AVI/ Van Nostrand Reinhold Publishing Co, 1989.
5. Cliver, D.D. Foodborne Diseases. Academic Press, Inc, 1990.
6. Food and Drug Administration. Bacteriological Analytical Manual (BAM) (8th 21 Edition). AOAC, Arlington, VA, 1995.
7. Debnath, 2005, Tools & Techniques of Biotechnology, Pointer Publishers, Jaipur.

FUNCTIONAL FOOD (Theory)

Course Objectives	1. *Understanding the basics of nutraceuticals and functional foods.* 2. *Study the significance of nutraceuticals and their role in disease prevention.* 3. *Knowledge of regulatory issues related to nutraceuticals and functional foods.*
Course Outcomes	CO1 Gaining knowledge about concept of nutraceutical and functional foods,their sources and role in prevention of chronic disorders. CO2 Learning methods for identification nutraceutically significant molecules. CO3 Understand the extraction procedures and formulation of functional food along with their stability and analytical issues. CO4 Knowledge of the adverse effects and toxicity issues of nutraceuticals.

Section A

Definition of Nutraceuticals/ Functional foods and related terms, rationale to claim a compound as a nutraceutical, regulatory issues of nutraceuticals based on CODEX/FSSAI. Concept of angiogenesis and health foods vs. disease. Role of functional food on age related macular degeneration, endurance performance and mood disorders-compounds and their mechanisms of action, dosage levels, contradictions if any.

Section B

Extraction of selected nuraceuticals. Formulation of functional foods containing nutraceuticals-stability and analytical issues, labelling issues. Identification testing of nutraceuticals and heath foods, interactions of prescription drugs and nutraceuticals, adverse effects and toxicity of nutraceuticals, Nutrigenomics-an introduction and its relation to nutraceuticals.

References Books

1.Robert EC. 2006. Handbook of Nutraceuticals and functional foods. Wildman.
2. Shi J. 2006 Functional food Ingredients and Nutraceuticals: Processing Technologies, CRC Press.
3.Webb GP. 2006. Dietary supplement and Functional Foods. Blackwell Publications.

INDUSTRIAL SAFETY & HAZARDS (Theory)

Course Objectives	1. To know about industrial safety programs and toxicology, industrial laws, regulations and source models 2. To understand about fire and explosion, preventive methods, explosives and inflammable substances. 3. To determine about industrial hazards and its risk assessment. 4. To analyze the effects of workplace exposures, injuries and illnesses, and the methods to prevent incidents using effective control strategies.
Course Outcomes	CO1: Identify the various types of hazards in work-place environment, protective and preventive measures in hazard control, Toxic Chemicals, maximum allowable concentrations and other standards. Biological threshold limit values. CO2: Recognize Mechanical and Electrical hazards, Explosives and inflammable substances, radioactive hazards CO3: Select appropriate Personal protective equipments and effective control strategies for Fire prevention. Good housekeeping in industrial environment. CO4: Understand Standard safety procedures and disaster control, OSHAS, OHSMS and OSHA. Current amendments in Indian Legislation on safety and prevention of hazards and safety code: ISO 14000, ISO9000. CO5: Describe Environmental impact assessment. Case studies of typical hazardous industries. CO6: Select proper control strategies for hazardous wastes.

SECTION-A

Definition, identification, classification and assessment of various types of hazards in work-place environment, protective and preventive measures in hazard control.

Toxic Chemicals: maximum allowable concentrations and other standards. Biological threshold limit values.

Mechanical and electrical hazards. Personal protective equipments. Explosives and inflammable substances. Radioactive hazards. Fire prevention. Good housekeeping in industrial environment.

SECTION-B

Standard safety procedures and disaster control. Indian Legislation on safety and prevention of hazards and safety code: ISO 14000. Environmental impact assessment. Control strategies for hazardous wastes.

Case Studies of typical hazardous industries.

***Books Recommended*:**

1. Wills, G.L. : Safety in Process Plant Design.
2. Less, F.P. : Loss Prevention in Process Industries.
3. Chanleft, E.T. : Environmental Protection.
4. Berhowex, P.M. & Rudd, D.F : Strategy of Pollution Control.
5. Safety for Chemical Engineers : A.I.Ch.E. Publications, 1976-77.

PLANT UTILITIES (Theory)

Course Objective	To teach the students about requirement and use of main utilities like compressed air, steam, water and refrigerants, which are required in process plants.

Course Outcome	CO1: Understand the selection of different utilities to run process plant. CO2: Analyze the use of compressed air through air compressore and vacuum pumps. CO3: Analyse of use of steam and or boiler. CO4: To analyse the power generation through IC engines and turbines. CO5: Understand the importance refrigeration and water resources.

SECTION-A

Importance of Process utilities in Chemical Plant.
Compressed air and Vacuum: Reciprocating air compressors, vacuum pumps, air receivers, piping systems.
Steam: Boiler, steam handling and distribution steam nozzles.

SECTION-B

Refrigeration: Air refrigeration cycle, vapour compression cycle, liquification processes.
Power Generation: Internal Combustion engines. Gas turbines, steam power plants.
Water: Water Resources, storage & distribution of water reuse & conservation of water.

***Books Recommended*:**

1. Jouganson, R. : Fan Engineering, Buffalo Rorge Co., 1970.
2. Wangham, D.A. : Theory and Practice of Heat Engines, ELBS Cambridge University Press, 1960.
3. Lyle, O. : Efficient Use of Steam, HMSO, 1963.
4. Stoccker, W.F. : Refrigeration and Air Conditioning, Mc-Graw Hill, 1950.
5. Kurl, W.F. J.H.M. : Reuse of Water in Industry, Butterworth, London.

Paper Title: Open Elective (Theory)

Course Duration: 45 Lectures of one hour each.

Note for the Paper setter: The question paper should be divided into Section A and Section B Total of 8 questions. 4 questions from section A and 4 questions from section B are to be set. The students will be required to attempt 5 questions selecting at least 2 from each section.

PROCESS INSTRUMENTATION (Theory)

Course Objectives	➢ To provide knowledge of pressure, temperature, level, humidity, viscosity, conductivity, humidity, pH, density and weight measurements. ➢ To provide knowledge of recording instruments, indicating and signalling instruments, control centre, transmission of instrument reading and instrumentation diagrams.
Course Outcomes	Upon successful completion of the course, the students will be able to: CO1: Classify elements and types of instruments, static and dynamic characteristics of instruments. CO2: Illustrate the different methods for the measurement of temperature and their useful applications. CO3: Elucidate the construction and working of various industrial devices used to measure pressure and vacuum. CO4: Explicate the construction and working of various industrial devices used to measure level. CO5: Discuss methods for measurement of viscosity, conductivity, humidity, density, weight and pH. CO6: Describe recording/indicating/signalling instruments and Control Centre. CO7: Construct Instrumentation diagrams.

SECTION-A

General Concept: Need and classification of measurements and instruments, Basic and auxiliary functional elements of a measurement system.

Static and Dynamic Characteristics of Instruments:

Static Characteristics: Range and span, accuracy and static error, reproducibility and drift, sensitivity and dead zone.

Dynamic Characteristics: Speed of response and lag, fidelity and dynamic error, dead time.

Temperature measurement:

Thermal expansion methods – bimetallic thermometers, liquid-in-glass thermometer and filled-in-system thermometers.

Thermocouples, metal resistance thermometers and thermistors, optical and radiation pyrometers, radiation receiving elements.

Pressure measurement:

Use of manometers, Bourdon gauge, bellows type gauge. Vacuum measurement–Mcleod gauge, thermoionic type ionization gauge, pirani vacuum gauge. Measurement of pressure in corrosive fluids: Diaphragm seal, liquid seal and purge system.

SECTION-B

Liquid level measurement:

Direct measurement of liquid level –Float & tape liquid level gauge, float and shaft liquid level unit, hydraulic remote transmission of liquid level.

Level measurement in open vessels: Bubbler system, diaphragm box system, air trap system. Level measurement in pressure vessels – Differential pressure manometer, use of liquid seals with a manometer, displacement float liquid level gauge. (6

Hrs.)
Measurement of viscosity, conductivity, humidity and pH.
Density measurement – liquid level method, displacement meter and hydrometer.
Measurement of weight – spring scale, pneumatic force meter and hydrostatic force meter.
Process Instrumentation–Recording instruments, indicating and signaling instruments, control centre, transmission of instrument reading, instrumentation diagrams.

***Books Recommended*:**

1. Eckman, Donald P. : Industrial Instrumentation, CBS Publisher and Distributors, Indian 2004.
2. Singh, S.K. : Industrial Instrumentation and Control, 2nd Edition, Tata McGraw – Hill, 2007.
3. Considine, D.N. : Process Instruments and Controls Handbook 2nd Edition, McGraw Hil
4. Fribance, A.E. : Industrial Instrumentation Fundamentals, Tata McGraw – Hill Publis Ltd., 1962.
5. Patranabis, D. : Principles of Industrial Instrumentation, 2nd Edition, Tata McG Publishing Co. Ltd., 1999.

FOOD REGULATION & QUALITY CONTROL (Theory)

Course Objectives	1. *To understand the need and importance of quality in food processing.* 2. *To impart knowledge of food safety and various laws associated with it.* 3. *To explain why microbiological quality control methods are necessary in food production.*
Course Outcomes	CO1 Understand the concept of quality and various quality attributes, their measurement and evaluation as well as the quality assessment of food materials on the basis of sensory evaluation. CO2 Learn various methods and techniques for measuring quality of processed and packaged food and recognizing the importance of microbiological methods in food production. CO3 Recognize the importance of food safety and different regulating authorities and food laws prevalent in India and worldwide for different food industries. CO4 Quality aspects of different food products and the effect of various factors on acceptability of the product along with chemical and physical methods employed for assessing the quality of food product.

SECTION-A

General Principles of Quality Control, Quality Attributes: Colour, gloss, viscosity and consistency, size, shape and texture, flavour, taste, sensory evaluation techniques.
Microbiological methods of quality evaluation. Application of Biosensors to check the quality of packaged food products

SECTION-B

Government and trade standards for quality.
Food Laws and Regulations: PFA, FPO, BIS, AGMARK, ISO, etc.
Quality of Different Food Products: Cereals, fruits, vegetables, milk, egg, meat, fish etc.

Books Recommended:

1. Krammar and Twigg : Quality Control for Food Industry, AVI Publishing, 1979.
2. Herschdoerfar, S.N. : Quality Control in Food Industry, Academic Press, U.K.
3. Ranganna : Handbook of Analysis of Fruit and Vegetable Products, Tata McGraw Hill, New Delhi, 1986.

FOOD QUALITY CONTROL & PACKAGING LAB. (Practical)

Course Objectives:

Assisting students use laboratory techniques and methods common to Food processing and packaging and to provide an opportunity to the students to evaluate the effective test methods used in sensory evaluation and analyse the resulting information.

Course Outcomes:

CO1 Understand the need and functions of quality control and various methods used for assessing the quality of food products.
CO2 Assessing the importance of packaging as a solution to various factors affecting food.
CO3 Gain knowledge on shelf life of food and various methods of estimating it.
CO4 Explain the different packaging materials and their properties.

Estimation of product quality with respect to the color, size, shape. Viscosity, texture, flavour, taste, sensor evaluation, market testing of products. Evaluation of food standards.
Packaging:

1. Strength properties of packaging materials.
2. Water vapour and gas transmission rates of flexible packaging materials.
3. Identification of plastic films.
4. Pre-packaging of vegetables.
5. Shrink packaging of poultry.
6. Estimation of shelf life of packaged foods.
7. Vacuum and gauge packaging.
8. Performance evaluation of transport packaging.

FOOD RHEOLOGY & TEXTURE (Theory)

Course Outcome

CO1 To provide knowledge about basic concept of stress and strain, elastic solids, fluid behaviour etc.
CO2 To provide knowledge about rheological behaviour of food, dynamic and static rheological property measurement methods of food, viscoelastic fluids.
CO3 To provide knowledge about description and measurement of solid food rheology using Farinograph; Mixograph; Cone Penetrometer; Warner-Bratzler Shear; Kramer Shear Cell; Melt Flow Indexer:
CO4. To provide knowledge about rheology of food hydrocolloids dispersions, food suspensions, pastes, gels, Dough, cheese, emulsions, method of measurement of texture of food material fruits and vegetables, extrudates etc.

Section A

Basic Concepts of Stress and Strain, Elastic Solids: Hookean and Non-Hookean Behavior Classification of Fluid Behavior: Newtonian and Non-Newtonian Fluids - Shear Dependence, Time Dependence, Mechanical Models, Determination of Flow Properties, Laminar Flow of Fluids, Circular Ducts, Between Parallel plates Modeling Rheological Behavior, Yield Stress Phenomena, Concepts of Dynamic and Static Yield Stresses, Viscoelastic Fluids, Measurement Methods: Extensional Flow; Empirical Measurement Methods and Texture Profile Analysis; Farinograph; Mixograph; Cone Penetrometer; Warner-Bratzler Shear; Kramer Shear Cell; Melt Flow Indexer

Section B

Pipeline Design Calculations for Non-Newtonian Fluids, Fanning Friction Factors: Power Law and Bingham Plastic Fluids, Laminar and Turbulent Friction Losses in Valves and Fittings, Velocity Profiles in Laminar and Turbulent Flows Rheology as structural analysis tool for a) Solid food materials b) Fluid and semi-solid food materials Description and measurement of solid food rheology: Dough, cheese, fruits and vegetables, extrudates Classification, description and measurement of fluid and semi-solid food rheology. Rheology of food hydrocolloids dispersions, food suspensions, pastes, gels, emulsion. Method of measurement (objective/instrumental) of texture of food material. Correlation with sensory method. Food products specific textural aattributes, TPA etc.

References Books

1. Steffe, J.F., Daubert, J.F. (2006) Bioprocessing Pipelines: Rheology and Analysis, East Lansing, MI, Freeman Press

2. Steffe, J.F. (1996) Rheological Methods in Food Process Engineering, Second Edition, East Lansing, MI, Freeman Press

3. Rao, M.A., Steffe, J.F. (1992) Viscoelastic Properties of Food, New York, Elsevier Applied Science

NANO TECHNOLOGY (Theory)

Course Objective	Students learn about nuances of Nanotechnology from basics to application such that they may be able to use this knowledge in their Professional Careers
Course Outcome	CO1: Understand the basis of nanotechnology in terms of bonding, types of nanomaterials. CO2 : Explain methods of synthesis and fabricating nanostructures (top down- bottom up). CO3: Relate the unique properties of nanomaterials to the reduced dimensionality of the material through characterisation. CO4 : Discuss applications of nanomaterials in various fields.

SECTION-A

Introduction: Plenty of room at the bottom-Feynman's concept, evolution of ultra-fine materials, the missing link between conventional laws in physics and chemistry and new theories.
Building Blocks of Nanotechnology: covalent architecture, coordinated architecture and weakly bound aggregates, Interactions and topology
Chemical Properties: The effect of nanoscale metals on chemical reactivity, effect of nanostructure on mass transport, metal nanocrystallites support on oxides, supported nanoscale catalysts.

General principles for synthesis of monodispersed nanoparticles, metals and intermetallics, Ceramics, composites, nanoparticles, colloids/Micelles/vesicles/Polymers/glasses, Crystalline, and zeolite hosts.
Review of fundamental behaviour of 0-D(nanoclusters), 1-D(nanowires), 2-D(thin film multilayers), and 3-D(bulk nanostructures) materials. Introduction to size dependent phenomenon in nanostructure for various applications, specific production techniques like chemical vapor deposition, arc ignition etc. Formation of clusters and nanoparticles from supersaturated vapor and selected properties, sputtering and thermal evaporation and laser methods. Synthesis of nanoparticles by chemical routes.

SECTION-B

Approches to production: Top down and bottom up, Mechanical attrition, high energy ball milling, and mechanical attrition, nanocomposites by mechano-chemistry, mechanism of grain size reduction, property of microstructure relationships.
Characterization techniques : Tools in nanotechnology: Scanning electron microscopy(SEM), Transmission electron microscopy and high resolution(TEM), energy dispersive spectroscopy (EDX), Atomic force microscopy(AFM), Magnetic force microscopy(MFM), Chemical Force Microscopy(CFM), Focused ion beam, nanolithography, powder x-ray diffractometry, UV visible.

Nanomaterials: CNTs, Polymer Nanocomposites nanoceramics, nanometals, nanopolymers, structures-properties-applications, Quantum dots. Concepts Bio-Nanotechnology.
Applications: Nanotherapeutics, Molecular diagnostics, tissue engineering, nanopumps, nanorobtoics cells, molecular motors, nanomembranes, Organic molecular based computers, bionanodevices (sensors & actuators).]

Books Recommended

1. *Nanoscale Materials in Chemistry* by Kenneth J. Khabhunde (ed.) Wiley Interscience.
2. *Nanotechnology – An introduction to nanostructure of technique* by Michel Kohler and Wolfgang Frittsche 2004- Wiley VCH
3. *Springer Handbook of Nanotechnology by Bharat Bhushan*
4. *Encyclopedia of Nanotechnology- Hari Singh Nalwa.*
5. *Nanostructures and Nanomaterials* by G. Cao, Imperial College Press, 2004
6. *Introduction to Nanotechnology* by Owen and Poole, Wiley
7. *Nano-materials* by A. K. Bandopadhyay, New Age International

SUPPLY CHAIN & LOGISTICS MANAGEMENT (Theory)

SECTION – A

Introduction to Supply Chain Management: Definition; Scope & Importance of Supply Chain Management; Key drivers Of the SCM; Features of Supply Chain Management; Supply Chain Network – 1st Tier , 2nd Tier; Network decisions in SCM; Suppliers and Customers; Customer Service Dimension (Seven "R" Principles, Service after sale, Customer delight)

Role of Logistics in Supply Chains: Definition of Logistics Management; Scope and role of Transportation, Traffic & transportation; Relationship between transportation and other business functions, Transport Economics: Distance – volume-density, Freight Cost, Handling, Liability, market factors; Third party logistics (3 PL) & fourth party logistics service provider (4 PL), Logistics equipment; Reverse Logistics, Government rule & regulations related to Logistics; Purchase Cycle, Make or Buy, Price analysis, Negotiations.

SECTION – B

Inventory Management: Inventory Control, Planning & Managing Inventories; Warehouse Management (Receipt, issue, storage and preservation, stock verification, In bound and out bound distribution operations); Order Management; Competitive advantage through logistics and supply chain management; Responsive Supply Chain; Supply chain process integration, performance measurement; Value Chain, Value System and Supply Chain.

Planning demand and supply: Planning & Sourcing in Supply Chain, Demand forecasting, Type and Time horizon of forecast and category of forecasting, aggregate planning; Financial issues in Supply Chain - Macro and micro view, Asset management, Du Pont Model, Supply Chain Costing;

Decision environment in SCM; Global supply chain perspectives - New business models, role of IT in SCM.

Suggested Readings:

1. Harald Dyckhoff et al, Ed.: Supply Chain Management and Reverse Logistics, Springer (India).
2. Jayashree Dubey and M.L. Saikumar Ed.: Supply Chain Management, IIPE Hyderabad and New Century Publication.
3. Sarika Kulkarni, Ashok Sharma: Supply Chain Management-Creating Linkages for Faster Business Turnaround, McGraw Hill.
4. RP Mohanty: Supply Chain Management-Theories and Practice, Biztantra.
5. Robert B. Handfield, Ernest L. Nicholas, Jr.: Introduction to Supply Chain Management,Pearson Education.
6. Ronald H. Ballou, Samir K. Srivastava: Business Logistics/Supply Chain Management, Pearson Education.
7. John Mentzer: Supply Chain Management, Response Books.
8. Janat Shah: Supply Chain Management, Pearson Publications.
9. N. Chandrasekaran: Supply Chain Management - Process, System and Practice, Oxford Press.

OPERATIONS RESEARCH (Theory)

CO1: Define and apply Linear Programming methods, describe problem formulation, graphical method, simplex method, duality sensitivity analysis and Transportation model based problems.

CO2: Describe Theory of Games, Algebraic, Graphical & Linear programming methods. Queuing Theory, elementary queuing system; single & multiple channel queuing model, , Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.

SECTION-A

Linear Programming: problem formulation, graphical method, simplex method, duality sensitivity analysis.

Transportation model, Transhipment problem, traveling salesman problem, Assignment models, Sequencing model, Replacement model.

SECTION-B

Theory of Games: Pure strategy games, principle of dominance; mixed strategy games (Algebraic, Graphical & Linear programming method), 2-person, non-zero- sum games.

Queuing Theory: Introduction, elementary queuing system; single channel queuing model, queuing cost behaviour, multiple channel queuing model, Poisson arrivals and Erlang service distribution; benefits and limitations of queuing theory.

***Books Recommended*:**

1. Vohra, N.D. : Quantitative Techniques in Management; 2nd Edition, Tata McGraw Hill.
2. Gupta, P.K. and Hira, D.S. : Operation Research, S. Chand, New Delhi.
3. Swarup Kanti, Gupta, P.K. and Man Mohan : Operation Research, 12th revised Edition, Sultan Chand & Sons, New Delhi;

PROJECT MANAGEMENT AND ENTREPRENEURSHIP (Theory)

Course Objectives	1. To understand basic concepts in the area of entrepreneurship 2. To know the role and importance of entrepreneurship for economic development 3. To develop personal creativity and entrepreneurial initiative 4. To adopt of the key steps in the elaboration of business idea 5. To know the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures. 6. To enable the students to evolve a suitable framework for the preparation, appraisal, monitoring and control of industrial projects.

	7. To make them understand the concepts of Project Management for planning to execution of projects. 8. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
Course Outcomes	CO1: To consider the legal and financial conditions for starting a business venture To evaluate the effectiveness of different entrepreneurial strategies CO2: To understand the nature of entrepreneurship and functions of the successful entrepreneur. To identify personal attributes that enable best use of entrepreneurial opportunities CO3: Explain the concept and attributes of projects, project management system, process and its principles, and various stages of a project. Perform technical feasibility, marketing feasibility and commercial viability using NPV, and further to understand tax and legal aspects of a project. CO4: Analyse project appraisal in public & private sector and estimate shadow prices and social discount rate. Examine project risk and performance assessment. Evaluate project management techniques using case studies.

SECTION-A

Introduction to Projects: Meaning & Definition of Project, Attributes of a Project, Difference among Projects, Routine Activities and Programs; Project Life Cycle

Project Planning: Work Breakdown Structure, Types of Work Breakdown Structure, Planning Framework and Its Importance

Project Feasibility: Marketing, Technical & Financial Feasibility

Social Cost Benefit Analysis: Rationale, UNIDO and Little Mirrlees Approaches

Project Schedule Planning; Network Analysis Techniques; Project Implementation; Project Monitoring & Control

SECTION-B

Entrepreneur- Meaning & Definition of Entrepreneur, Characteristics of Entrepreneur, Nature and importance of Entrepreneur, Functions, Entrepreneur V/s Manager, Women Entrepreneurs.

Entrepreneurship: Concept, Policies Governing Entrepreneurs, Entrepreneurial Development Programmes, Contribution of Entrepreneurship to Economic Development

Institutions for Entrepreneurial Development; Role of Various Commercial Banks and Development financial Institutions.

Books Recommended

1. UNIDO: Guidelines for Project Evaluation, United Nations, reprinted,1993..
2. Mannual for the preparation of Industrial Feasibility Studies, United Nations 1995.
3. Manual for Evaluation of Industrial Projects, United Nations, reprinted on 1993..
4. IMD little and J.A. Mirrlees: Project Apraisal and Planning in Developing Countries, 1975.
5. Prasanna Chandra: Projects: Preparation, Appraisal Budgeting and Control, 7th edition, TMH.
6. Vasanta Desai: Dynamics of entrepreneurial development and management, 11th edition, Himalaya pub.
7. Vasanta Desai: Entrepreneurial development, and Management, 13th edition, Himalaya pub., Harper Collins, edition- Paperback.
8. Peter F. Drucker: Innovation and development.