Semester Wise Course Structure
& Evaluation Scheme

for

B. TECH. DEGREE PROGRAMME

IN

CHEMICAL TECHNOLOGY (OIL TECHNOLOGY)

(Effective from the session 2022-23)

Department of Oil Technology

School of Chemical Technology
Harcourt Butler Technical University Kanpur-208002
Uttar Pradesh

Department of Chemical Technology-Oil Technology

I) Vision

Transforming the individuals into globally competent Chemical Technologist (Oil Technologist) to fulfill technological needs of industry and society in large.

II) Mission

We are committed to:

- Provide quality education through innovation in teaching and learning practices meeting the global standards
- Encourage faculty and students to carry out socially relevant and forward looking research
- Offer consultancy services using state of the art facilities fulfilling the needs of the industry and society
- Enable our students, faculty and staff to play leadership roles for the betterment of the society in a sustainable manner

III) Programme Educational Objectives (PEO) for B Tech Oil Chemical Technology-Oil Technology Programme:

PEO1. Graduates of the programme will contribute to the development of sustainable growth of engineering and Oil technology sector for the betterment of society

PEO2. Graduates of the programme, as an employee of an organization or as an employer, will continuously update their domain knowledge for continuous professional development with focus on research & development and industry interaction

PEO3 Graduates of the programme will accept and create innovations in providing solution for sustainable technology development

PEO4 Graduates of the programme will discharge their duties as professional engineer and Oil Technologist with quality and ethics

Programme Outcomes (POs) of B.Tech Chemical Technology - Oil Technology

Graduating Students of B. Tech. Chemical Technology- Oil Technology programme will:

Programme Outcomes(POs)		Graduate Attributes
PO1.	Apply the knowledge of mathematics, science, engineering fundamentals and Engineering concepts for the solution of complex Engineering problems	Engineering Knowledge
PO2.	Identify, formulate, review literature and analyze complex problems related to Chemical Technology-Oil Technology reaching substantiated conclusions using first principles of mathematics and engineering sciences.	Problem Analysis
PO3.	Design solutions for complex problems in Chemical Technology-Oil Technology and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	Design/Development of solutions
PO4.	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	Conduct Investigations of complex
PO5.	Create, select, and apply appropriate techniques, resources, and modern engineering tools such as optimization techniques, simulations, including prediction and modeling to complex process Engineering problems with an understanding of their limitations.	Modern Tool Usage
PO6.	Apply contextual knowledge with justification to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering and Chemical Technology-Oil Technology professional practice	The Engineer & Society
PO7.	Understand the impact of the professional engineering and Chemical Technology-Oil Technology solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	Environment and Sustainability
PO8.	Apply ethical principles and commit to professional ethics adhering to the norms of the engineering and Chemical Technology-Oil Technology practice	Ethics
PO9.	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	Communication
PO10.	Communicate effectively on complex engineering and Chemical Technology-Oil Technology activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Individual and Team work
PO11.	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	Lifelong Learning
PO12.	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage engineering and Chemical Technology-Oil Technology projects and in multi disciplinary environments.	Project management & Finance

Harcourt Butler Technical University, Kanpur

School of Chemical Technology

B. Tech. Programme

SEMESTER WISE COURSE STRUCTURE

(Applicable from Session 2022-23 for new entrants)

B. TECH. CHEMICAL TECHNOLOGY- OIL TECHNOLOGY

Year-I, Semester-I

Sl. No.	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab.	Total		
1	BSC	NPH 101/102	Engineering Physics	4	3	0	2	15	20	15	50	50	100
2	BSC	NMA101/102	Engineering Mathematics-I	4	3	1	0	30	20	-	50	50	100
3	ESC	NEE101/102	Introduction to Electrical Engineering	4	3	0	2	15	20	15	50	50	100
4	ESC	NME101/102	Introduction to Mechanical Engineering	4	3	1	0	30	20	-	50	50	100
5	HSMC	NHS101/102	Professional Communication	4	3	0	2	15	20	15	50	50	100
6	ESC	NCE101/102	Engineering Graphics	2	0	0	4	30	20	-	50	50	100
Total				22									600

Year-I, **Semester-II**

Sl. No.	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab.	Total		
1	BSC	NCY101/102	Engineering Chemistry	4	3	0	2	15	20	15	50	50	100
2	ESC	NCS101/102	Introduction to Computer Science and Engineering	4	3	1	0	30	20	-	50	50	100
3	ESC	NET101/102	Introduction to Electronics Engineering	4	3	1	0	30	20	-	50	50	100
4	ESC	NCE101/102	Introduction to Civil Engineering	4	3	1	0	30	20	-	50	50	100
5	NCT	NCT101/102	Introduction to Chemical Engineering and Chemical Technology	4	3	1	0	30	20	-	50	50	100
6	ESC	NWS101/102	Workshop Practice	2	0	0	4	-	20	30	50	50	100
Total				22									600

Harcourt Butler Technical University, Kanpur

School of Chemical Technology

B. Tech. Programme

SEMESTER WISE COURSE STRUCTURE

(Applicable from Session 2023-24 for new entrants)

B. TECH. CHEMICAL TECHNOLOGY- OIL TECHNOLOGY

Year- II, Semester-III

Sl. No.	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab.	Total		
1	BSC	NMA-201	Engineering Mathematics-II	4	3	1	0	30	20	-	50	50	100
2	ESC	NCT-201	Fluid Mechanics and Mechanical Operations	4	3	0	2	15	20	15	50	50	100
3	PCC	NCT-203	Chemical Process Calculations	3	3	0	0	30	20	-	50	50	100
4	HSMC	NHS-201	Economics & Management	3	3	0	0	30	20	-	50	50	100
5	PCC	NOT-201	Chemistry of Oil & Allied Products	4	3	1	0	30	20	-	50	50	100
6	PCC	NOT-203	Source Composition Characterization of Oils, Fats & Waxes	4	3	1	0	30	20	-	50	50	100
7	PCC	NOT-205	Oil & Oilseed Analysis Lab	2	0	0	4	-	20	30	50	50	100
Total Credits				24									700

Year- II, **Semester-IV**

Sl. No.	Course Type	Subject Code	Course Title	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab.	Total		
1	BSC	NCY 202	Modern Analytical Techniques	4	3	1	0	30	20	-	50	50	100
2	ESC	NMA 204	Computer Oriented Numerical Methods	4	3	0	2	15	20	15	50	50	100
	PCC	NCT 202	Heat Transfer Operation	3	3	0	0	30	20	-	50	50	100
	PCC	NCT 204	Chemical Engineering Thermodynamics	4	3	1	0	30	20	-	50	50	100
3	PCC	NOT 202	Expression & Extraction Technique of Oil Bearing Materials	4	3	1	0	30	20	-	50	50	100
6	PCC	NOT 204	Essential Oil and Cosmetics	3	3	0	0	-	20	30	50	50	100
7	PCC	NOT 206	Oil Characterization Lab	2	0	0	4	30	20	-	50	50	100
Total Credits				24									700

Harcourt Butler Technical University, Kanpur

School of Chemical Technology

B. Tech. Programme

SEMESTER WISE COURSE STRUCTURE

(Applicable from Session 2024-25 for new entrants)

B. TECH. CHEMICAL TECHNOLOGY- OIL TECHNOLOGY

Year- III, Semester-V

Sl. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab.	Total		
1	HSMC	Entrepreneurship	NHS 301	2	2	0	0	30	20	-	50	50	100
2	PCC	Mass Transfer Operations	NCT 307	3	3	0	0	30	20	-	50	50	100
3	PCC	Chemical Reaction Engineering	NCT 309	3	3	0	0	30	20	-	50	50	100
4	PCC	Technology of Soaps & Fat Splitting	NOT 301	4	3	1	0	30	20	-	50	50	100
5	PCC	Refining of Oils	NOT 303	4	3	1	0	30	20	-	50	50	100
6	PCC	Environmental Aspects of Oils & Allied Industries	NOT 305	3	3	0	0	30	20	-	50	50	100
7	PCC	Analysis of Soap & detergent Products Lab	NOT 307	3	0	0	6	-	20	30	50	50	100
Total Credits				22									700

Year- III, **Semester-VI**

Sl. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab.	Total		
1	PCC	Instrumentation & Process Control	NCT 302	4	3	0	2	15	20	15	50	50	100
2	PCC	Advanced Oil Chemistry & Oleochemicals	NOT 302	4	3	1	0	30	20	-	50	50	100
3	PCC	Technology of Surfactants & Synthetic Detergents	NOT 304	3	3	0	0	30	20	-	50	50	100
4	PCC	Hydrogenation & Modification of Oils	NOT 306	3	3	0	0	30	20	-	50	50	100
5	PCC	Detergent product preparation and formulation Lab	NOT 308	3	0	0	6	-	20	30	50	50	100
6	PEC-1	Program Elective-I	NCT 322 NCT 324 NCT 326	3	3	0	0	30	20	-	50	50	100
7	OEC-I	Introduction to Oils and Oil Processing	OOT- 302	2	2	0	0	30	20	-	50	50	100
Total Credits				22									700

Harcourt Butler Technical University, Kanpur

School of Chemical Technology

B. Tech. Programme

SEMESTER WISE COURSE STRUCTURE

(Applicable from Session 2025-26for new entrants)

B. TECH. CHEMICAL TECHNOLOGY- OIL TECHNOLOGY

Year –IV, Semester-VII

Sl. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	PEC-II	Program Elective II	NOT 401 NOT 403 NOT 405	4	3	1	0	30	20	-	50	50	100
2	PEC-III	Program Elective III	NOT 407 NOT 409 NOT 411	3	3	0	0	30	20	-	50	50	100
3	PEC-IV	Program Elective IV	NOT 413 NOT 415 NOT 417	3	3	0	0	30	20	-	50	50	100
4	Industrial Training	Industrial Training	NOT 419	2	0	0	4	-	20	30	50	50	100
5	OEC-II	Technology of Soaps	OOT 401	2	2	0	0	30	20	-	50	50	100
6	Minor Project	Minor Project	NOT 471	6	0	0	12	-	20	30	50	50	100
7	Seminar	Seminar	NOT 473	2	0	0	4	-	50	-	50	50	100
Total Credits				22									700

Year –IV, **Semester-VIII**

Sl. No.	Course Type	Course Title	Subject Code	Credits	Periods			Sessional Marks				ESE	Total Marks
					L	T	P	MSE	TA	Lab	Total		
1	PEC-V	Program Elective- V	NOT 402 NOT 404 NOT 406	4	3	1	0	30	20	-	50	50	100
2	OEC-III	Technology of Surface Active Agents	OOT 402	2	2	0	0	30	20	-	50	50	100
3	Project	Project	NOT 492	16	0	0	24	-	100	100	200	200	400
Total Credits				22									600

Total Credits: 180

List of Programme Elective Courses

Sl. No.	PEC Names	Subject Name	SubjectCode	Credits
1	Programme Elective Course I	• Process Equipment Design • Process Modeling and Simulation • Process Optimization	NCT-322 NCT-324 NCT-326	3(3,0,0)
2	Programme Elective Course II	• Commerce, Process Economics, and Safety Management in Oil Industries • Biotechnology of Oils & Oil Seeds • Lipid Biotechnology	NOT 401 NOT 403 NOT 405	4(3,1,0)
3	Programme Elective Course III	• Quality Assurance of Oils and Allied Products • Packaging of Oils, Fats & Allied Industries • By-products Utilization and Waste Management	NOT 407 NOT 409 NOT 411	3(3,0,0)
4	Programme Elective Course IV	• Petroleum Products & Petrochemicals • Nutraceuticals and Functional Additives • Fuel & Green Lubricants	NOT 413 NOT 415 NOT 417	3(3,0,0)
5	Programme Elective Course V	• Perfumery and Cosmetic Technology • Green and Modern Technologies applied in Oils and Allied Products • Introduction to processing tools related to oil processing	NOT 402 NOT 404 NOT 406	4(3,1,0)

List of Courses for Minor degree in Chemical Technology- Oil Processing and Oleo chemicals

Sl. No.	Course Type	Course Title	Subject Code	Credits	Sessional Marks				ESE	Total Marks
					MSE	TA	Lab	Total		
1.	PCC	Chemistry of Oil & Allied Products	NOT-201	4 (3,1,0)	30	20	-	50	50	100
2.	PCC	Advanced Oil Chemistry & Oleo chemicals	NOT 302	4(3,1,0)	30	20	-	50	50	100
3.	PCC	Expression & Extraction Technique of Oil Bearing Materials	NOT 202	4 (3,1,0)	30	20	-	50	50	100
4.	PCC	Refining of Oils	NOT 307	4 (3,1,0)	30	20	-	50	50	100
5.	PCC	Hydrogenation & Modification of Oils	NOT 306	3(3,0,0)	30	20	-	50	50	100
6	PCC	Technology of Surfactants & Synthetic Detergents	NOT 304	3 (3,0,0)	30	20	-	50	50	100
Total Credits				**22**						

List of Courses for Honours Degree in Chemical Technology- Oil Technology

Student will be awarded B.Tech. Honours degree in Chemical Technology- Oil Technology if he/she earn 20 extra credits from the list given below, provided he/she doesn't repeat the subject already covered in completing 180 credits required for award of B.Tech. Degree in Chemical Technology- Oil Technology:

Sl. No.	PEC Names	Subject Name	Subject Code	Credits
1	Programme Elective Course I	• Process Equipment Design • Process Modeling and Simulation • Process Optimization	NOT-312 NOT-314 NOT-316	3(3,0,0)
2	Programme Elective Course II	• Commerce, Process Economics, and Safety Management in Oil Industries • Biotechnology of Oils & Oil Seeds • Lipid Biotechnology	NOT 401 NOT 403 NOT 405	4(3,1,0)
3	Programme Elective Course III	• Quality Assurance of Oils and Allied Products • Packaging of Oils, Fats & Allied Industries • By-products Utilization and Waste Management	NOT 407 NOT 409 NOT 411	3(3,0,0)
4	Programme Elective Course IV	• Petroleum Products & Petrochemicals • Nutraceuticals and Functional Additives • Fuel & Green Lubricants	NOT 413 NOT 415 NOT 417	3(3,0,0)
5	Programme Elective Course V	• Perfumery and Cosmetic Technology • Green and Modern Technologies applied in Oils and Allied Products • Introduction to processing tools related to oil processing	NOT 402 NOT 404 NOT 406	4(3,1,0)

NPH-101/102 : ENGINEERING PHYSICS

L: T: P: C
3: 0: 2: 4

Course Objective:

The objective of the course is to understand the basic concepts of nature around us and to synthesize the knowledge from different areas of physics for analysing and solving various critical problems.

Course Outcome (CO):
On successful completion of the course, the students will be able to :

CO1	Understand and apply the principle of conservation of momentum, the theory of relativity.	K2, K1
CO2	Understand the basics of quantum mechanics and apply its principles to learn the phenomenon that occurs at subatomic dimensions.	K3, K1
CO3	Understand Maxwell's equations of electromagnetic theory with the aim to apply them in a communication system.	K5, K1
CO4	Apply the fundamentals of material science, especially to dielectric materials, semiconducting materials, nanomaterials, and Superconducting Materials.	K2, K1
CO5	Understand the statistical behavior of the constituent particles and apply the principles of statistical mechanics in the formation of materials and basics of LASERs	K4, K1

K1-Remember, K2- Understand, K3-Apply, K4-Analyse, K5-Evaluate, K6-Create

Course Articulation Matrix (CO-PO Matrix)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	1	2	1	2	-	-	-	-	-	3
CO2	3	3	1	2	1	2	-	-	-	-	-	3
CO3	3	3	1	2	1	2	-	-	-	-	-	3
CO4	3	3	3	2	1	3	3	-	-	-	-	3
CO5	3	3	2	3	3	3	-	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

UNIT- 1

Relativistic Mechanics:

Inertial and Non- Inertial Frames of references, Galilean transformation equations, Michelson Morley Experiment, Lorentz Transformation equations, Length contraction, Time dilation and its experimental evidence, Relativistic velocity addition formula, Relativistic variation of mass with velocity, Evidence of variation of mass with velocity, Einstein's Mass-Energy equivalence, examples from nuclear physics, Relativistic energy momentum relation.

UNIT- 2

Quantum Mechanics:

Dual nature of matter & radiation, Heisenberg's uncertainty Principle and their applications, wave packet concept, Davisson-Germer experiment, Postulates of quantum mechanics, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases.Applications of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional cases), Simple harmonic oscillator (one dimensional case).

UNIT- 3

Electromagnetic Theory:

Ampere's law and Faraday's law of electromagnetic induction, Derivation of Maxwell's equations and their physical significance, Correction of Ampere's law by Maxwell, Concept of displacement current, Poynting theorem, Maxwell's equations in free space & velocity of electromagnetic waves, Transverse character of the wave and orthogonality of E, H and k vectors, Maxwell's equation in dielectric medium and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media & solution of differential equation in this case, penetration depth & its significance.

UNIT- 4

Statistical Mechanics & Lasers:

Macrostates and Microstates, Phase space, probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applications of Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above cases, Bose-Einstein Statistics & its application in case of black body radiation, distribution law of energy, Planck's radiation formula, derivation of Wien's law, Rayleigh-Jeans law and Stefan's law from Planck's radiation formula. Fermi – Dirac statics, application in case of free electrons in metals, energy distribution, Fermi energy.

Lasers: Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, solid state lasers, properties of laser beams, mono- chromaticity, coherence, directionality and brightness, applications of lasers in various technological applications.

UNIT- 5

Materials of Technological Importance:

Dielectric Materials: Electric field in presence of dielectric medium, concept of electric polarization, different types of polarizations, behaviour of dielectric in a.c. field, concept of dielectric loss and loss energy and their importance.

Semiconducting Materials: Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors, amorphous semiconductors.

Nano Materials: Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

Superconducting Materials: Resistivity and susceptibility of Superconductors, Type – I and Type – II superconductors, Meissner effect, Low temperature Superconductors, Organic Superconductors, Oxide Superconductors, High temperature Superconductors, BCS theory (Qualitative).

Text Books:

1. Engineering Physics, R. K. Shukla, Pearson Education, Vol.-II, 2014
2. Electrical Engineering Materials, R.K. Shukla, McGraw Hill, 1st Edition, 2012
3. Principles of Engineering Physics, R.K. Shukla, Ira Books, 1st Edition, 2011
4. Engineering Physics –I & II, S.K. Gupta, Krishna Prakashan Media (P) Ltd., 2014

Reference Books

1. Fundamental university physics, Vol. - I: Mechanics, Marcelo Alonso, J. Finn Edwards, Addison-Wesley, 1st Edition, 1967
2. Concepts of Modern Physics, Arthur Beiser, McGraw Hill, 6th Edition, 2003
3. Introduction to Electrodynamics, David Griffiths, Cambridge University Press, 4th Edition, 2017
4. Introduction to Solid State Physics, Charles Kittel, Willey, 8th Edition, 2005
5. Introduction to Nanotechnology, Charles P. Poole Jr., Frank J. Owens, Wiley-Interscience, 1st Edition, 2003

Web links

1. https://nptel.ac.in/courses/122101002 [IIT Bombay, Prof. D.K. Ghosh]
2. https://nptel.ac.in/courses/122103011 [IIT Guwahati, Prof. Alika Khare , Prof. Pratima Agarwal, Prof. S. Ravi]
3. https://nptel.ac.in/courses/115105099 [IIT Kharagpur, Prof. Amal Kumar Das]
4. https://nptel.ac.in/courses/115101005 [IIT Bombay, Prof. D.K. Ghosh]
5. https://nptel.ac.in/courses/115106066 [IIT Madras, Prof. S. Lakshmi Bala]

ENGINEERING MATHEMATICS –I

(Semester-I & II: I-B.Tech, All Branches)

Course Code: NMA-101/102 **L-T-P-C:** 3-1-0-4

OBJECTIVE: The objective of this course is to educate the students about:

- the convergence of infinite series, improper integrals, and differential calculus.
- partial differentiation, multiple integrals and Beta, Gamma functions.
- vector calculus, matrices, linear algebra, and optimization techniques.

Course Outcome: On the successful completion of the course, students will be able to

CO1	find nth derivative, determine the expansion of functions, and find convergence of series and improper integrals.	K1, K2
CO2	find partial differentiation and evaluate area and volume using multiple integrals.	K2, K5
CO3	convert line integrals to surface integrals and volume integrals, determine potential functions for irrotational force fields.	K3, K5
CO4	solve linear system of equations and determine the eigen vectorsof the matrix.	K3, K4, K5
CO5	learn concept of optimization and optimization techniques.	K1, K2

CO-PO Mapping:

CO	PO1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12
CO1	3	3	2	1	2	-	-	1	-	1	-	3
CO2	3	3	2	1	2	-	-	1	-	1	-	3
CO3	3	3	2	1	2	-	-	1	-	1	-	3
CO4	3	3	2	1	2	-	-	1	-	1	-	3
CO5	3	3	2	1	2	-	-	1	-	1	-	3
Average e	3	3	2	1	2	-	-	1	-	1	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is nocorrelation, put "- "

Detailed Syllabus:

Unit I- Functions of One Real Variable: 6 hours

Successive differentiation, Leibnitz theorem, Mean value theorems, sequences and series, expansion of functions, improper integrals, and their convergence.

Unit II- Functions of Several Real Variables: 10 hours

Limit, Continuity, Partial differentiation, Total differential and approximations, Jacobian, Euler'stheorem for expansion of functions, Beta and Gamma Functions, Multiple integrals, change oforder, Change of variables, Applications to area, volume, mass, surface area etc. Dirichlet's Integral & applications.

Unit III- Vector Calculus: 8 hours

Point functions, differentiation, Differential operators: Gradient, Laplacian, Hessian, Directional derivative; Divergence and Curl of a vector and their physical interpretations, Solenoidal & irrotational fields, Integration: Line, Surface and Volume integrals, Green's, Stoke's and Gauss Divergence theorems (without proof) and applications

Unit IV- Matrices and Linear Algebra: 10 hours

Vector space and subspace, linear dependence, basis and dimensions, Linear transformation and its matrix representation, Elementary transformations, Echelon form, rank & nullity, consistency of linear system of equations and their solutions, characteristic equation, Cayley Hamiltontheorem, real and complex eigenvalues and eigenvectors, diagonalization, SVD, quadratic forms, complex, orthogonal, and unitary matrices, Application to Cryptography, discrete, Compartmental models, and system stability.

Unit V- Optimization: 6 hours

Engineering applications of optimization, statement and classification of optimization problems, Optimization techniques, single and multi-variable optimizations with no constraint, with equality and inequality constraints, Linear Programming Problems, Graphical method, and Simplex method.

Textbooks:

1. R.K. Jain & S. R. K. lyengar; Advanced Engineering Mathematics, Narosa Publishing House2002.
2. Erwin Kreyszig: Advanced Engineering Mathematics. John Wiley & Sons 8th Edition.
3. Dennis G. Zill & Michael R Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers, 2nd Edition.
4. S.S. Rao; Optimization: Theory & application Wiley Eastern Limited.

Reference Books:

1. T.M. Apostol, calculus, Vol. I, 2nd ed., Wiley 1967.

2. T.M. Apostol, Calculus, Vol. II, 2nd ed., Wiley 1969.

3. Gilbert Strang, Linear Algebra & its applications, Nelson Engineering 2007.

4. Calculus & Analytic Geometry, Thomas and Finny.

NEE-101/102 : INTRODUCTION TO ELECTRICAL ENGINEERING

C[L-T-P] : 4 [3-0-2]

Course Objectives

The goal of the course is to make the students understand the basic principles of electrical engineering.

Course Outcomes

At the end of the course the students will be able to:

CO1. apply Mesh and Nodal Methods of Analysis and Network Theorem in DC Network.

CO2. understand and analyze the ac circuit and calculate the various parameters.

CO3. understand and analyze the 3-phase connections of source and load, and, measurement of 3-phase power.

CO4. understand the magnetic circuit with working & applications and to calculate the various parameters of magnetic circuits and transformer efficiency.

CO5. understand the basic principles of AC & DC Machines

Course Articulation Matrix (CO-PO Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2		1					2		2
CO2	3	1			1					2		2
CO3	3			3	1					2		2
CO4	3				1					2		2
CO5	3		2		1					2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

UNIT 1 - DC Circuit Analysis and Network Theorems

Circuit Concepts: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R L and C as linear elements. Source Transformation. Kirchhoff's Law, loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (Simple Numerical Problems)

UNIT 2 - Steady State Analysis of Single Phase AC Circuits

Sinusoidal, Square and Triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits. (Simple Numerical Problems)

UNIT 3 - Three Phase AC Circuits

Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage / current relations, three phase power and its measurement. (Simple Numerical Problems)

UNIT 4 - Magnetic Circuits and Transformer

Magnetic Circuit: Magnetic circuit concepts, analogy between Electric & Magnetic circuits, Magnetic circuits with DC and AC excitations, Magnetic leakage. B-H curve, Hysteresis and Eddy Current losses, Magnetic circuit calculations.

Single Phase Transformer: Principle of Operation, Construction, e.m.f. equation, Power losses, efficiency. (Simple Numerical Problems)

UNIT 5 - Electro Mechanical Energy Conversion

Basic Principles of electro mechanical energy conversion.

DC Machines: Types of DC machines, e.m.f. equation of generator and torque equation of motor, Speed-Torque characteristics of DC Series and Shunt Motors, Applications of dc motors. (Simple Numerical Problems).

Three Phase Induction Motor: Types, Principle of Operation, Slip – torque Characteristics, applications. (Simple Numerical Problems).

Single Phase Induction Motor: Basic Principles of 1-phase Induction Motor and its applications

Three Phase Synchronous Machines: Principle of Operation of alternator and synchronous motor and their applications.

List of Experiments

1. Verification of Kirchhoff's laws.
2. Verification of Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Measurement of power and power factor in a 1 – Ø ac series inductive circuit and study improvement of power factor using capacitor.
6. Study of phenomenon of resonance in RLC series circuit and obtain the resonant frequency.
7. Measurement of power in 3 – Ø circuit by Two Wattmeter method and determination of its power factor.
8. Determination of parameter of ac 1 – Ø series RLC Circuit.
9. Determination of Efficiency by load test of a 1 – Ø Transformer.
10. To study running and speed reversal of a 3 – Ø induction motor and record its speed in both direction.

Note:

a. Department may add any three experiments in the above list.
b. Minimum eight experiments are to be performed out of the above list.

Text books:

1. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International
2. I. J. Nagarath, "Basic Electrical Engineering" Tata Mc - Graw Hill
3. D. E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering" Mc - Graw Hill
4. B. L. Theraja and A. K. Theraja, "Basic Electrical Engineering: July 1999.

Reference books:

1. Edward Hughes, "Electrical Technology" Longman
2. T. K. Nagsarkar & M. S. Sukhija, "Basic Electrical Engineering" Oxford University Press
3. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing
4. W. H. Hayt & J. E. Kennely, "Engineering Circuit Analysis" Mc - Graw Hill

NME-101/102 : INTRODUCTION TO MECHANICAL ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Objectives:

To explain the basic fundamentals of forces, moments, stresses, strains, fundamental of fluid and fluid flow application, fundamentals of thermodynamics and mode of heat transfers.

Course Outcomes (CO):

At the end of this course students should be able to:

CO1	Understand the basic laws concepts of mechanical systems.	K2, K1
CO2	Determine resultants and apply conditions of static equilibrium to plane force systems.	K3, K1
CO3	Analyze beam for shear force and bending moment along the span and analyze trusses for axial forces.	K4, K1
CO4	Evaluate the structural properties centroid and moment of inertia	K5, K1
CO5	Stress analysis for one- and two-dimensional stress systems.	K3, K1

K1- Remember, K2- Understand, K3-Apply, K4-Analyse, K5- Evaluate, K6- Create

Course Articulation Matrix (CO-PO Matrix)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3			1	1	1	1	1		1
CO2	3	3	3									1
CO3	3	3	3									1
CO4		3	2	2								1
CO5		3	2	2								1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content:

UNIT-1: Fundamental Concepts and Definitions:

Mechanical Engineering: Scope and expanse

Concept of machines and mechanisms, classification of machines.

Thermodynamic systems, Laws of thermodynamics. Introduction to modes of heat transfer, applications.

Materials, classification, selection of materials in design of components.

Manufacturing processes, mechanical working of metals.

UNIT-2:

Two-Dimensional Force Systems: Basic concepts, laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distributed force system, free body diagrams, equilibrium and equations of equilibrium, applications.

Friction: Introduction, Laws of Coulomb friction, Equilibrium of bodies involving dry-friction, belt friction, applications.

UNIT-3:

Beam: Introduction, Shear force and bending moment, differential equations for equilibrium, shear force and bending moment diagrams for statically determinate beams.

Trusses: Introduction, simple truss and solution of simple truss, Method of joints and method of sections.

UNIT-4: Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes theorem, Perpendicular axes theorems, Principal moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere and cone about their axis of symmetry.

UNIT-5: Introduction to Strength of Materials: Introduction, normal and shear stresses, stress- strain diagrams for ductile and brittle material, elastic constants, One Dimensional loading of members of varying cross- sections, strain energy, 2D state of plane stress, Principal stresses and strains.

Text books:

1. Engineering Mechanics by Abhijit Chanda and Debabrata Nag, Wiley India Pvt. Ltd, 2018, Kindle - Edition, ISBN: 9788126570935.
2. Engineering Mechanics: Statics by J L Meriam. L G Kraige. Virginia Polytechnic Institute and State University, John Wiley & Sons, 2017.ISBN-978-8126564033.
3. Engineering Mechanics of Solids, Egor P. Popov, PHI Publications, 1990.
4. Theory of Machines and Mechanisms by J.E. Shigley, Oxford University Press, 5th Edition, 2017.
5. Engineering Thermodynamics by P K Nag, TMH Publication, 4th Edition, 2008.

Reference Books:

1. Theory of Machines and Mechanisms by Amitabha Ghosh and Asok Kumar Mallick, Affiliated East-West Press, 3rd Edition, ISBN: 9788185938936.
2. Engineering Mechanics by Timoshenko S., McGraw-Hill Education – Europe, 5th Edition, 2013.
3. Engineering Mechanics by Nelson A, McGraw Hill Education India, 1st Edition, ISBN-978-0070146143, 2017
4. Materials and Manufacturing: An Introduction to How they Work and Why it Matters by Mark A Atwater McGraw-Hill Education, 1st Edition, ISBN: 9781260122312, 2018
5. Engineering Thermodynamics: Work and Heat Transfer by Rogers, Pearson Education India, 4th Edition, 2002.

Web Links:

1- https://nptel.ac.in/courses/112106286 [IIT Madras, Prof. K. Ramesh]
2- https://nptel.ac.in/courses/112103108 [IIT Guwahati, Prof. US Dixit]
3- https://nptel.ac.in/courses/112103109 [IIT Guwahati, Prof. US Dixit]
4- https://eng.utq.edu.iq/wp-content/uploads/sites/4/2019/09/engineering-mechanics-lectures.pdf[Thi-Qar University, Prof. Haider]
5- https://www.youtube.com/watch?v=tisNUzd_f1M&t=96s [Dr. V. P. Singh, HBTU, Kanpur]
6- https://www.youtube.com/watch?v=a6RNss9kBuI&t=11s [Dr. V. P. Singh, HBTU, Kanpur]
7- https://www.youtube.com/watch?v=LE1Lc6_640U[Dr. V. P. Singh, HBTU, Kanpur]

NHS 103 / 104 : PROFESSIONAL COMMUNICATION

C [L-T-P]: 4[3 0 2]

Course Objectives

- Critically think about communication processes and messages.
- Write effectively for a variety of contexts and audiences.
- Interact skillfully and ethically.
- Develop and deliver professional presentations

Course Outcomes (CO)

At the end of this course students should be able to:

CO1	Effectively communicate their ideas in the contemporary global competitive environment.	K2, K1
CO2	Convey their messages through constructive writing.	K3, K1
CO3	Draft potent E-Mails, letters, proposals and reports.	K4, K1
CO4	Present their presentations along with using all nuances of delivery with clarity and thoroughness.	K5, K1
CO5	Solve problems based on real time situations and articulate them eventually.	K3, K1

K1- Remember, K2- Understand, K3-Apply, K4-Analyse, K5- Evaluate, K6- Create

Course Articulation Matrix (CO-PO Matrix of selected Course): NHS 103/104

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	0	0	0	0	0	0	2	3	0	1
CO2	0	0	0	0	0	0	0	0	2	3	0	1
CO3	0	0	0	0	0	0	0	0	2	3	0	1
CO4	0	0	0	0	0	0	0	0	2	3	0	1
CO5	0	0	0	0	0	0	0	0	2	3	0	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

UNIT I

Fundamentals of Technical Communication

Process of communication, language as a tool of communication, levels of communication , flow of communication, barriers to communication, communication across cultures; Technical Communication: meaning, significance, characteristics, difference between technical and general communication.

UNIT II

Elements of Written Communication

Words and phrases, word formation, synonyms and antonyms, homophones, one word substitution, sentence construction, paragraph construction,

UNIT III

Forms of Technical Communication

(A) business letters, job application letter and resume, 7C's of letter writing, business letters: sales & credit letters, letters of enquiry, letters of quotation, order, claim and adjustment letters, official letters: D.O. letters, government letters, letters to authorities, etc. ,

(B) Technical Reports: general format of a report, formal and informal reports, memo report, progress report, status report, survey report, trip report, complaint report, , Joining Report ,laboratory report, research papers, dissertations and theses. E-mail writing

Technical Proposals: purpose, characteristics, types, structure

UNIT IV

Presentation Strategies

Defining the subject, scope and purpose, analysing audience & locale, collecting materials, preparing outlines, organising the contents, Pre-presentation strategies, during presentation strategies, nuances of delivery, verbal and non-verbal communication, Body language, paralinguistic features of voice, visual aids.

UNIT V

Value-based Text Reading

(A) Study of the following essays from the text book with emphasis on writing skills:

1. Man and Nature	by J. Bronowski
2. The Language of Literature and Science	by Aldous Huxley
3. The Aims of Science &The Humanities	by Moody E Prior
4. Gods in this Godless Universe	by Bertrand Russell
5. Science and Survival	by Barry Commoner

(B) Readings of selected short stories:

1. The Renunciation	by Rabindranath Tagore

2. The Lament	by Anton P. Chekhov
3. The Barber's Trade Union	by Mulk Raj Anand
4. The Eyes Are Not Here	by Ruskin Bond

Professional Communication Laboratory

Interactive practical sessions with emphasis on oral presentations / spoken communication:

Practical Sessions on:

1. Group Discussions: selected topical issues to be discussed in groups.
2. Mock interviews
3. Communication skills for seminars/conferences/workshops with emphasis on non-verbal skills.
4. Presentation skills for technical papers/project reports/professional reports.
5. Theme presentation/ key note presentation based on correct argumentation methodologies.
6. Argumentative skills
7. Role play
8. Comprehension skills based on reading and listening practice, asking questions.
9. Introduction to International Phonetics Alphabets
10. Audio Visual demonstration of effective communicative strategies & TED Talks
11.

Text Books

1. Improve Your Writing Edited By V N Arora and Laxmi Chandra, Oxford University Press, First Edition, New Delhi, 2013.
2. An Anthology of English Short Stories, Edited by R P Singh, First Edition, 2015, Oxford University Press.
3. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Third Edition, 2015, Oxford University Press, New Delhi.
4. Sethi and Dhamija, 'A Course in Phonetics and Spoken English', Second Edition, 2004, Prentice Hall of India, New Delhi.
5. Joans Daniel, 'English Pronouncing Dictionary', 18th Edition, 2011, Cambridge University Press.

Reference Books

1. Effective Technical Communication, by Barun K Mitra, First Edition, 2008, Oxford University Press.
2. Business Correspondence & Report Writing by R.C. Sharma & Krishna Mohan, Fifth Edition, 2017, Tata McGraw Hill, N.D.
3. Developing Communication Skills by Krishna Mohan & Meera Banerjee, Second Edition, 2000, Macmillan India
4. Technical Communication- Principles and Practices by M R S Sharma, Third Edition, 2015, Oxford University Press, New Delhi
5. R. K. Bansal & J.B. Harrison, Spoken English for India, Orient Longman, Fourth Edition, 2013, Orient Blackswan, Hyderabad.
6. Excellence in Business Communication, 13th Edition, 2020 Publisher-Pearson Education.

Web Links:

1. https://nptel.ac.in/courses/109104030 [Dr. T Ravichandran, IIT Kanpur]

NCE-103/104 : ENGINEERING GRAPHICS

C[L-T-P]: 2[0-0-4]

Course Outcomes

At the end of this course, students should be able:

CO1	To understand and apply the concepts of lettering, dimensioning, scales and geometric construction
CO2	To visualize the position and location of any point, line, plane, or surface and draw their orthographic projections
CO3	To visualize and draw/develop the true shape, size, and sections of solid objects the true shape, size, and specifications of physical objects
CO4	To apply the visualization skill, to draw a simple isometric and perspective projections
CO5	To understand and draw basic civil Engineering building components using AutoCAD

Course Articulation Matrix (CO-PO Matrix)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	1	2	-	-
CO2	2	-	-	-	-	-	-	-	1	2	-	-
CO3	2	-	-	-	-	-	-	-	1	2	-	-
CO4	2	-	-	-	-	-	-	-	1	2	-	-
CO5	2	-	-	-	3	-	-	-	1	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit –I

Lettering and Dimensioning: Introduction, lettering practices, Rules of dimensioning – systems of dimensioning.
Geometric Constructions: Freehand sketching, Conic Sections, Special Curves.
Engineering Scales

Unit –II

Orthographic Projection

Projection of Points: First and Third Angle Projections; Projection of Points
Projection of Lines: Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both planes, true length and true inclinations.
Projection of solids: Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane.

Unit –III

Sections of Solids: Right regular solids and auxiliary views for the true shape of the sections.
Development of Surfaces: Development of surfaces for various regular solids.

Unit –IV

Isometric Projection: Isometric scales, Isometric projections of simple and combination of solids;
Perspective Projection: Orthographic representation of perspective views – Plane figures and simple solids – Visual Ray Method.
Conversion of pictorial view into orthographic Projection.

Unit –V

Introduction to Auto CAD, Drawings of Buildings and their components – front view, top view, and sectional views of a typical residential building using Auto CAD.
Detailed Drawing of RCC Design- Slab, beam, column, footings.

Textbooks

1. D.A. Jolhe (2008). '*Engineering Drawing- With an Introduction to AutoCAD.',* Tata Mcgraw, Delhi.
2. N D Bhatt and V M Panchal (2001). '*Engineering Drawing.'*, 43rd Ed., Charotar Publishing House, Anand, 2001.
3. M B Shah and B C Rana (2009). '*Engineering Drawing.',* 2nd Ed., Pearson Education, Delhi.

Reference Books

1. A Textbook of Engineering Graphics by K.V. Natarajan.
2. T E French, C J Vierck and R J Foster, *Graphic Science and Design*, 4th Ed., McGraw Hill, 1984.
3. W J Luzadder and J M Duff, *Fundamentals of Engineering Drawing*, 11th Ed., PHI, 1995.
4. K Venugopal, *Engineering Drawing and Graphics*, 3rd Ed., New Age International, 1998

Web Resources

https://nptel.ac.in/courses/112103019

https://nptel.ac.in/courses/112102304

https://nptel.ac.in/courses/112105294

https://archive.nptel.ac.in/courses/112/102/112102304/

Year-I, **Semester-II**

NCY-101 / 102: ENGINEERING CHEMISTRY

C[L-T-P] : 4 [3-0-2]

OBJECTIVE:

The objective of this course is to make students learn the laboratory skills needed to design safe conduction of reactions and experiments in Chemistry. The student will acquire a foundation of Chemistry to enable them to understand and critically interpret the primary research in Chemistry.

Course outcome

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

CO1	Interpret UV-Visible and IR-Spectra	K2, K4
CO2	Describe reaction rates for reactions of various orders	K2, K3, K4
CO3	Understand different aspects of corrosion and thermodynamic view of electrochemical processes, reversible, irreversible cells and nano chemistry	K2, K3
CO4	Understand the stereochemistry of molecules and identify organic reactions on the basis of their mechanism	K1, K3, K4
CO5	Distinguish between different polymeric structures, classify polymers, and analyze the polymerization mechanism and use of polymers in different walks of life. Knowledge of conductivity of polymer, biodegradable polymers and fibre reinforced plastics. Acquire knowledge about water and treatment of municipal water and solid waste management	K2, K3, K5, K6
CO6	To develop experimental skills to perform, monitor and manipulate the reactions.	K2, K4, K5

K1-Remember, K2-Understand, K3-Apply, K4-Analyse, K5- Evaluate, K6-Create

Course Articulation Matrix (CO-PO Matrix)

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	3	3	2	2	2	2	1	2	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

UNIT- 1

Bonding VSEPR Theory, Valence Bond Theory, Crystal-field theory, Electronic Spectra and Ligands (strong and weak field), Phosphorescence and Fluorescence, Jablonski diagram, hydrogen bonding and their effect on physical properties, Metallic bonds, Classification and Applications of Liquid crystals, Band Theory of Solids and superconductors.

Spectroscopy Basic Principles, Instrumentation and Applications of UV-Vis and IR Spectroscopy.

UNIT- 2

Chemical Kinetics Second order reactions. Determination of order, Fast and slow reaction, steady state approximation, Temperature effect, Concept of Activated Complex / Transition State: Energy of activation, Potential energy surface, Theories of reaction rate: Collision and Transition State theories in terms of enzyme catalysis.

Surface Chemistry Introduction, Types of adsorption, Adsorption isotherms, BET, Applications of adsorption.

UNIT- 3

Electrochemistry Dry and fuel cells, electrochemical cell, Solar cells, Disensitized cell, Photovoltaiccell.

Nanochemistry Introduction, general methods of synthesis, classification and applications of nano materials.

Environmental Chemistry Air and Water Pollution, analysis of gaseous effluents oxides of Nitrogen, oxides of Sulphur and H_2S, chemical analysis of effluents liquid streams, BOD, COD, control of pollution, Depletion of ozone layer.

UNIT- 4

Stereochemistry Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers & Diastereomers, E-Z nomenclature, R-S configuration, Atropisomerism, and Optical isomerism in Allenes, biphenyl and Spiranes, Circular Dichroism.

Reaction Mechanism Inductive, Electromeric and Mesomeric effects. Study of reaction intermediates (Carbanion, carbocation, carbene, nitrene and benzyne). Mechanism of nucleophilic and electrophilic substitution reactions. Mechanism and application of following reactions:

a) Suzuki-Miyaura Cross coupling reaction
b) Fries and Photo-Fries Rearrangement
c) Wagner-Meerwein Rearrangement
d) Umpolung Reactions
e) Favorskii Rearrangement

UNIT- 5

Polymers: Introduction, types of polymers, Molecular mass-number and mass average molecular weight, determination of molecular mass by Osmometry, viscosity, light scattering and size exclusion

chromatography, Rheological properties and uses of some common polymers. Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Conducting and Biodegradable polymers.

Water Analysis: Introduction; Hardness of Water- cause, types, units, Disadvantages of using hard water for domestic and industrial purposes, Softening of hard water, Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness, Numerical based on determination of hardness.

Solid Waste Management: Classification, waste treatment & Disposal methods (Composting, sanitary land filling, thermal processes, recycling and reuse).

List of Experiments:

1. Determination of alkalinity in given water sample.
   i. Sodium Carbonate & Sodium Bicarbonate
   ii. Sodium Carbonate & Sodium Hydroxide
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of Chloride content of water by Mohr's Method.
4. Determination of Chlorine content in Bleaching powder.
5. Determination of strength of supplied Ferrous Ammonium Sulphate (FAS) solution in using external, internal indicators.
6. Determination of viscosity of a given liquid by Ostwald's viscometer.
7. Determination of surface tension of a given liquid by Stalagmometer.
8. pH metric titration.
9. Determination of Dissociation constant of weak acids by conductometric Titration.
10. To prepare aspirin (acetyl salicylic acid) from salicylic acid.
11. Synthesis of polyurethanes
12. Find the concentration of the given samples using UV-visible spectroscopy.

Textbooks

1. A Text Book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co., Fifth Edition, 2017.

Reference Books:

1. Organic Chemistry by I. L. Finer, *Vol-1, Ninth Edition, 2015, Pearson Publisher.*
2. Physical Chemistry by Puri, Sharma & Pathania, Vishal Publishing Co., 48th Edition, 2021, ISBN: 978-93-87015-81-4
3. Polymer Science by V. R. Gowarikar, N. V. Vishwanathan and J. Shridhar, Wiley Eastern Ltd., New Delhi, 1987, ISBN: 978-0470203224.
4. Elementary Organic Spectroscopy by Y.R. Sharma, S. Chand, Fifth Edition, 2013, ISBN: 9788121928847.

Web links

1. https://nptel.ac.in/courses/104101121 [Prof. Debabrata Maiti, IIT Bombay]
2. https://nptel.ac.in/courses/104106119 [Prof. Harinath Chakrapani & Prof. Neeraja Dashaputre, IIT Madras]
3. https://nptel.ac.in/courses/104105084 [Prof. Debashis Ray, IIT Kharagpur]
4. https://nptel.ac.in/courses/104106129 [Prof. M. V. Sangaranarayanan, IIT Madras]

NCS-101/102: INTRODUCTION TO COMPUTER SCIENCE AND ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Outcomes (COs):

To explain the fundamentals of the computer system in terms of hardware components and basics of an operating system, understanding of programming, database management systems, and working with Internet and web applications.

At the end of this course students should be able to:

CO 1	Understand hardware components of computer systems such as memory system organization, and input/output devices, and be aware of software components of computer system	Understand	K1
CO 2	Understand Operating systems and be able to develop basic shell scripts.	Understand, Apply	K1, K2
CO 3	Develop a basic understanding of programming and get a concept of algorithmic thinking.	Apply, Analyze	K2, K3
CO 4	Understand Databases, Use SQL to write queries.	Understand, Evaluate	K1, K4
CO 5	Explain how the Internet works and be able to make basic static Web applications.	Understand, Create	K1, K5

K1-Understand, K2-Apply, K3-Analyse, K4-Evaluate, K5-Create

Course Articulation Matrix (CO-PO Matrix)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	1	-	-	1	1	1	1	1
CO4	3	2	2	3	1	-	-	-	1	-	2	1
CO5	3	2	3	1	2	1	1	2	2	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit - 1

Fundamentals of Computers: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution, and History of Computers, Types of Computers, Basic Organization of a Digital Computer; Classification of Digital Computer Systems: Microcomputers, Minicomputers, Mainframes, Supercomputers. Number Systems, Computer Codes – BCD, Gray Code, ASCII, and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Types of Software – System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High-Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program – Data Structures, Algorithm, Flowchart and Pseudo code with Examples.

Unit-2

Operating System Fundamentals: Operating Systems: Introduction, Functions of an Operating System, Classification of Operating Systems, System programs, Application programs, Utilities, The Unix Operating System, Basic Unix commands, Microkernel Based Operating System, Booting.

Unit-3

Fundamentals of C Programming Language: Introduction to C Programming Languages, Structure of C programs, compilation and execution of C programs, Debugging Techniques, Data Types and Sizes, Declaration of variables, Modifiers, Identifiers and keywords, Symbolic constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.

Operators: Unary operators, Arithmetic & logical operators, Bitwise operators, Assignment operators and expressions, Conditional expressions, Precedence, and order of evaluation.

Control statements: if-else, switch, break, and continue the comma operator, goto statement. Loops: for, while, do-while. Functions: built-in and user-defined, function declaration, definition and function call, and parameter passing: call by value, call by reference, recursive functions. Arrays: linear arrays, multidimensional arrays, passing arrays to functions, Arrays, and strings.

Unit-4

Introduction to Database Management Systems: Database, DBMS, Why Database -File system vs DBMS, Database applications, Database users, Introduction to SQL, Data types, Classification of SQL-DDL with constraints, DML, DCL, TCL

Unit-5

Internet Basics: Introduction, Features of the Internet, Internet application, Services of the Internet, Logical and physical addresses, Internet Service Providers, Domain Name System.

Web Basics: Introduction to web, web browsers, http/https, URL, HTML5, CSS

Text Books:

1. Kernighan B.W., Ritchie D.M., “The C Programming Language”, 2nd Edition, Prentice Hall Software, 2015

2. V. Rajaraman, “Fundamentals of Computers”, 6th Edition, PHI Learning Pvt. Ltd., 2015
3. Peter Norton’s, “Introduction to Computers”, 7th Edition, Tata McGraw Hill, 2017
4. David Riley and Kenny Hunt, “Computational Thinking for Modern Solver”, Chapman & Hall/CRC, 1st Edition, 2014

Reference:

1. J. Glenn Brook shear,” Computer Science: An Overview”, Addision-Wesley, Twelfth Edition, 2017
2. R.G. Dromey, “How to Solve it by Computer”, PHI, 1982
3. Balagurusamy E., “Fundamentals of Computers”, Second ed. 2009, McGraw Hill
4. Thareja R., “Fundamentals of Computers”, 2014, Oxford University Press.

Web link:

https://onlinecourses.swayam2.ac.in/cec19_cs06/preview

NET-101/102 : INTRODUCTION TO ELECTRONICS ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Objective
To understand the fundamentals of analog & digital electronic devices like diode, transistor, logic gates, flip-flop and to understand the working principles of common Instruments used in electronic measurement.

Course Outcomes (CO):
At the end of this course students should be able to:

CO1	To understand the basic concept of diodes, and use the diode as a circuit element for different applications.	K2,K3
CO2	To understand the working of BJT, FET and OP-amp and their application.	K2, K3, K6
CO3	To design the simple digital circuits using different logic gates.	K4, K6
CO4	To identify the errors while making electronic measurements and to understand the working of different types of transducers.	K1, K4, K5
CO5	To understand the working principle of electronic instruments and displaying it on electronic devices.	K1, K2, K4

K1- Remember, K2- Understand, K3-Apply, K4-Analyse, K5- Evaluate, K6- Create

Course Articulation Matrix (CO-PO Matrix)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	-	-	-	-	-	-	-
CO2	2	3	3	3	2	2	-	-	-	-	-	-
CO3	3	2	1	3	2	1	-	-	-	-	-	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-
CO5	3	1	3	2	1	-	-	-	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit-I:
P-N Junction Diode, Depletion layer, Barrier potential, forward and reverse bias, Knee voltage, V-I Characteristics and its Equivalent Models, Avalanche and Zener Break Down, Diode Applications as Half Wave, Full Wave & Bridge Rectifier and their comparative analysis, Clippers, Clampers, Voltage Multiplier Circuit, Zener Diode and its Applications as a voltage regulator, Varactor diode.

Unit-II:
Basic theory and operation of PNP and NPN transistors, Characteristics of Common Base, Common Emitter and Common Collector configuration, DC Biasing : Fixed Bias, Emitter Bias, voltage divider bias, Field effect transistor: JFET, Drain and Transfer characteristic, MOSFET, Introduction to Operational Amplifier and its Applications as Adder, Subtractor, Integrator, Differentiator, log antilog.

Unit-III:

Number System, Base Conversion, BCD code, Excess-3 code, Gray Code, Review of Logic Gates, Concept of Universal Gates &, Boolean laws and theorems, SOP and POS representation of Boolean functions, Minimization of Boolean functions using K map, Basic Combinational Circuits: Half Adder, Full Adder, Subtractor, Sequential Circuits: Latch, Flip-Flops, Characteristic and Excitation Table of SR, JK, D and T Flip-flop. Concept of Master Slave Flip- Flop, Shift Registers.

Unit-IV:
Functional Elements of Instruments, Classification & Characteristics, Types of Errors, Sources of Error, Dynamic Characteristics, Active and Passive Transducers: Resistive Transducers, Thermistor, Strain Gauge, Thermocouple, Differential Output Transducers, LVDT and their Characteristics.

Unit-V:
Display Devices: LCD, LED, Seven Segment Display, Alphanumeric Display, Electronic Ammeter and Voltmeter, Digital Multi-meter, Cathode Ray Oscilloscope (CRO), Digital Storage Oscilloscope (DSO)

Text Books:

1. Electronics Principles by Albert Malvino, & David Bates, 2016, Tata McGraw-Hill, Eigth Edition, ISBN- 978-0-07-337388-1
2. Electronic Devices & Circuit Theory by Boylestad, Robert & Nashelsky, 2015, Louis, Prentice Hall of India. Eleventh Edition, ISBN- 10-9332542600
3. Electronic Instrumentation and Measurements by H.S. Kalsi, 2019, Tata McGraw-Hill, Fourth Edition, ISBN-10- 9353162513
4. Digital Principles and Applications by Leach, Malvino, & Saha, 2014, Tata McGraw-Hill, 8th Edition, ISBN-10- 9789339203405

Reference Books:

1. Microelectronic Circuits by Adel Sedra, Kenneth C.(KC) Smith, Tony Chan Carusone, Vincent Gaudet, 2020, Oxford University Press, 8th Edition, ISBN-10-0190853468
2. A Course in Electrical and Electronic Measurements and Instrumentation by A K Sawhney 2021, Dhanpat Rai & sons, ISBN-10- 8177001000
3. Fundamentals of Microelectronics by Behzad Razavi, Wiley, Second Edition, ISBN-13:9781118156322

Web Links:

1. https://nptel.ac.in/courses/108101091
2. https://nptel.ac.in/courses/122106025

NCE-101/102 : INTRODUCTION TO CIVIL ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Outcomes

At the end of this course students should be able to:

CO1	To understand the overview and scope of Civil Engineering and apply the fundamentals of Surveying
CO2	To understand the various types of Civil Engineeringmaterials
CO3	To understand the basic concepts of water and wastewater quality, infrastructure, and also the basics of different pollution
CO4	To understand the basics of Highways, Railways and Airport Engineering
CO5	To understand the basics of various Civil Engineering structures

Course Articulation Matrix (CO-PO Matrix)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	2	-	-	-	-	-	1
CO1	2	-	-	-	-	2	-	-	-	-	-	1
CO2	2	-	-	-	-	2	3	-	-	-	-	1
CO3	2	-	-	-	-	2	3	-	-	-	-	1
CO4	2	-	-	-	-	2	3	-	-	-	-	1
CO5	2	1	1	-	-	2	1	-	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit-1: Introduction

Civil Engineering: Overview and scope of Civil Engineering, Civil Engineering landmarks, Job opportunities in Civil Engineering

Fundamentals of Surveying: Introduction, Types of Surveying - Chain, Compass, levelling and contouring, Total Station, Introduction to Remote Sensing/ GIS/ GPS

Unit-2: Civil Engineering materials

Building materials : Bricks, Stones, Cement, Aggregate, Concrete, RCC, Steel, Timber, Tiles, lime, paint.

Highway materials: bitumen, concrete, Surkhi, sand, stone dust

Soil: Types of soil, classification of soil.

Unit-3: Environmental Engineering

Water and Wastewater Quality, Drinking Water Standards, Water infrastructure- Intake, Treatment plants, distribution system, and household plumbing. Waste waterinfrastructure- household drainage system, sewerage system, Treatment Plant, and, disposal, effluent standards. Introduction to Air Pollution, Air Quality Index, Air quality standards, Solid Waste Management- collection and segregation, Noise Pollution-standards

Unit-4: Transportation Engineering

Highway Engineering: Introduction, Model, elemental and functional classification of Transportation System, IRC classification of roads, Typical cross-section of pavements, Control system.
Railway Engineering: Types of rails, Components of permanent way, stations
Airport- Components of the airport Introduction to Docks, Harbour, and Inland waterways

Unit-5: Civil Engineering Structures

Introduction to buildings: Elements- slab, beam, column, footing

Introduction to various Civil Engineering Structures- Bridges,Retaining Wall, Tanks and Reservoirs, Hydraulic Structures-Dams, Canals, Weirs, Barrage,Industrial Structures

Textbooks

1. S.S. Bhavikatti (2010). 'Basic Civil Engineering.', 1st edition, New Age International Publishers, New Delhi
2. Sateesh Gopi (2009). 'Basic Civil Engineering.', Pearson Publishers, Delhi, India
3. Punmia, B.C., Jain, A.K. and Jain, A.K. (2003). 'Basic Civil Engineering.', Laxmi Publications, New Delhi.

Reference Books

1. An Introduction to Civil Engineering by V. Okumu, CreateSpace Independent Publishing Platform.
2. Penn M. R. and Parker P. J. "Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering" John Wiley & Sons 2011.

Web Resources

https://nptel.ac.in/courses/105106201

Year-I, **Semester-II**

NCY-101 / 102: ENGINEERING CHEMISTRY

C[L-T-P] : 4 [3-0-2]

OBJECTIVE:

The objective of this course is to make students learn the laboratory skills needed to design safe conduction of reactions and experiments in Chemistry. The student will acquire a foundation of Chemistry to enable them to understand and critically interpret the primary research in Chemistry.

Course outcome

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

CO1	Interpret UV-Visible and IR-Spectra	K2, K4
CO2	Describe reaction rates for reactions of various orders	K2, K3, K4
CO3	Understand different aspects of corrosion and thermodynamic view of electrochemical processes, reversible, irreversible cells and nano chemistry	K2, K3
CO4	Understand the stereochemistry of molecules and identify organic reactions on the basis of their mechanism	K1, K3, K4
CO5	Distinguish between different polymeric structures, classify polymers, and analyze the polymerization mechanism and use of polymers in different walks of life. Knowledge of conductivity of polymer, biodegradable polymers and fibre reinforced plastics. Acquire knowledge about water and treatment of municipal water and solid waste management	K2, K3, K5, K6
CO6	To develop experimental skills to perform, monitor and manipulate the reactions.	K2, K4, K5

K1-Remember, K2-Understand, K3-Apply, K4-Analyse, K5- Evaluate, K6-Create

Course Articulation Matrix (CO-PO Matrix)

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	1	3	2	-	2	-	-	-	-	3
3	3	3	3	2	2	2	2	1	2	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

UNIT- 1

Bonding VSEPR Theory, Valence Bond Theory, Crystal-field theory, Electronic Spectra and Ligands (strong and weak field), Phosphorescence and Fluorescence, Jablonski diagram, hydrogen bonding and their effect on physical properties, Metallic bonds, Classification and Applications of Liquid crystals, Band Theory of Solids and superconductors.

Spectroscopy Basic Principles, Instrumentation and Applications of UV-Vis and IR Spectroscopy.

UNIT- 2

Chemical Kinetics Second order reactions. Determination of order, Fast and slow reaction, steady state approximation, Temperature effect, Concept of Activated Complex / Transition State: Energy of activation, Potential energy surface, Theories of reaction rate: Collision and Transition State theories in terms of enzyme catalysis.

Surface Chemistry Introduction, Types of adsorption, Adsorption isotherms, BET, Applications of adsorption.

UNIT- 3

Electrochemistry Dry and fuel cells, electrochemical cell, Solar cells, Disensitized cell, Photovoltaiccell.

Nanochemistry Introduction, general methods of synthesis, classification and applications of nano materials.

Environmental Chemistry Air and Water Pollution, analysis of gaseous effluents oxides of Nitrogen, oxides of Sulphur and H_2S, chemical analysis of effluents liquid streams, BOD, COD, control of pollution, Depletion of ozone layer.

UNIT- 4

Stereochemistry Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers & Diastereomers, E-Z nomenclature, R-S configuration, Atropisomerism, and Optical isomerism in Allenes, biphenyl and Spiranes, Circular Dichroism.

Reaction Mechanism Inductive, Electromeric and Mesomeric effects. Study of reaction intermediates (Carbanion, carbocation, carbene, nitrene and benzyne). Mechanism of nucleophilic and electrophilic substitution reactions. Mechanism and application of following reactions:

f) Suzuki-Miyaura Cross coupling reaction
g) Fries and Photo-Fries Rearrangement
h) Wagner-Meerwein Rearrangement
i) Umpolung Reactions
j) Favorskii Rearrangement

UNIT- 5

Polymers: Introduction, types of polymers, Molecular mass-number and mass average molecular weight, determination of molecular mass by Osmometry, viscosity, light scattering and size exclusion

chromatography, Rheological properties and uses of some common polymers. Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Conducting and Biodegradable polymers.

Water Analysis: Introduction; Hardness of Water- cause, types, units, Disadvantages of using hard water for domestic and industrial purposes, Softening of hard water, Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness, Numerical based on determination of hardness.

Solid Waste Management: Classification, waste treatment & Disposal methods (Composting, sanitary land filling, thermal processes, recycling and reuse).

List of Experiments:

13. Determination of alkalinity in given water sample.
    i. Sodium Carbonate & Sodium Bicarbonate
    ii. Sodium Carbonate & Sodium Hydroxide
14. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
15. Determination of Chloride content of water by Mohr's Method.
16. Determination of Chlorine content in Bleaching powder.
17. Determination of strength of supplied Ferrous Ammonium Sulphate (FAS) solution in using external, internal indicators.
18. Determination of viscosity of a given liquid by Ostwald's viscometer.
19. Determination of surface tension of a given liquid by Stalagmometer.
20. pH metric titration.
21. Determination of Dissociation constant of weak acids by conductometric Titration.
22. To prepare aspirin (acetyl salicylic acid) from salicylic acid.
23. Synthesis of polyurethanes
24. Find the concentration of the given samples using UV-visible spectroscopy.

Textbooks

2. A Text Book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co., Fifth Edition, 2017.

Reference Books:

5. Organic Chemistry by I. L. Finer, *Vol-1, Ninth Edition, 2015, Pearson Publisher.*
6. Physical Chemistry by Puri, Sharma & Pathania, Vishal Publishing Co., 48th Edition, 2021, ISBN: 978-93-87015-81-4
7. Polymer Science by V. R. Gowarikar, N. V. Vishwanathan and J. Shridhar, Wiley Eastern Ltd., New Delhi, 1987, ISBN: 978-0470203224.
8. Elementary Organic Spectroscopy by Y.R. Sharma, S. Chand, Fifth Edition, 2013, ISBN: 9788121928847.

Web links

5. https://nptel.ac.in/courses/104101121 [Prof. Debabrata Maiti, IIT Bombay]
6. https://nptel.ac.in/courses/104106119 [Prof. Harinath Chakrapani & Prof. Neeraja Dashaputre, IIT Madras]
7. https://nptel.ac.in/courses/104105084 [Prof. Debashis Ray, IIT Kharagpur]
8. https://nptel.ac.in/courses/104106129 [Prof. M. V. Sangaranarayanan, IIT Madras]

NCS-101/102: INTRODUCTION TO COMPUTER SCIENCE AND ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Outcomes (COs):

To explain the fundamentals of the computer system in terms of hardware components and basics of an operating system, understanding of programming, database management systems, and working with Internet and web applications.

At the end of this course students should be able to:

CO 1	Understand hardware components of computer systems such as memory system organization, and input/output devices, and be aware of software components of computer system	Understand	K1
CO 2	Understand Operating systems and be able to develop basic shell scripts.	Understand, Apply	K1, K2
CO 3	Develop a basic understanding of programming and get a concept of algorithmic thinking.	Apply, Analyze	K2, K3
CO 4	Understand Databases, Use SQL to write queries.	Understand, Evaluate	K1, K4
CO 5	Explain how the Internet works and be able to make basic static Web applications.	Understand, Create	K1, K5

K1-Understand, K2-Apply, K3-Analyse, K4-Evaluate, K5-Create

Course Articulation Matrix (CO-PO Matrix)

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	1	-	-	1	1	1	1	1
CO4	3	2	2	3	1	-	-	-	1	-	2	1
CO5	3	2	3	1	2	1	1	2	2	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit - 1

Fundamentals of Computers: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution, and History of Computers, Types of Computers, Basic Organization of a Digital Computer; Classification of Digital Computer Systems: Microcomputers, Minicomputers, Mainframes, Supercomputers. Number Systems, Computer Codes – BCD, Gray Code, ASCII, and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Types of Software – System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High-Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program – Data Structures, Algorithm, Flowchart and Pseudo code with Examples.

Unit-2

Operating System Fundamentals: Operating Systems: Introduction, Functions of an Operating System, Classification of Operating Systems, System programs, Application programs, Utilities, The Unix Operating System, Basic Unix commands, Microkernel Based Operating System, Booting.

Unit-3

Fundamentals of C Programming Language: Introduction to C Programming Languages, Structure of C programs, compilation and execution of C programs, Debugging Techniques, Data Types and Sizes, Declaration of variables, Modifiers, Identifiers and keywords, Symbolic constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.

Operators: Unary operators, Arithmetic & logical operators, Bitwise operators, Assignment operators and expressions, Conditional expressions, Precedence, and order of evaluation.

Control statements: if-else, switch, break, and continue the comma operator, goto statement. Loops: for, while, do-while. Functions: built-in and user-defined, function declaration, definition and function call, and parameter passing: call by value, call by reference, recursive functions. Arrays: linear arrays, multidimensional arrays, passing arrays to functions, Arrays, and strings.

Unit-4

Introduction to Database Management Systems: Database, DBMS, Why Database -File system vs DBMS, Database applications, Database users, Introduction to SQL, Data types, Classification of SQL-DDL with constraints, DML, DCL, TCL

Unit-5

Internet Basics: Introduction, Features of the Internet, Internet application, Services of the Internet, Logical and physical addresses, Internet Service Providers, Domain Name System.

Web Basics: Introduction to web, web browsers, http/https, URL, HTML5, CSS

Text Books:

5. Kernighan B.W., Ritchie D.M., “The C Programming Language”, 2nd Edition, Prentice Hall Software, 2015

6. V. Rajaraman, “Fundamentals of Computers”, 6th Edition, PHI Learning Pvt. Ltd., 2015
7. Peter Norton’s, “Introduction to Computers”, 7th Edition, Tata McGraw Hill, 2017
8. David Riley and Kenny Hunt, “Computational Thinking for Modern Solver”, Chapman & Hall/CRC, 1st Edition, 2014

Reference:

5. J. Glenn Brook shear,” Computer Science: An Overview”, Addision-Wesley, Twelfth Edition, 2017
6. R.G. Dromey, “How to Solve it by Computer”, PHI, 1982
7. Balagurusamy E., “Fundamentals of Computers”, Second ed. 2009, McGraw Hill
8. Thareja R., “Fundamentals of Computers”, 2014, Oxford University Press.

Web link:

https://onlinecourses.swayam2.ac.in/cec19_cs06/preview

NET-101/102 : INTRODUCTION TO ELECTRONICS ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Objective
To understand the fundamentals of analog & digital electronic devices like diode, transistor, logic gates, flip-flop and to understand the working principles of common Instruments used in electronic measurement.

Course Outcomes (CO):
At the end of this course students should be able to:

CO1	To understand the basic concept of diodes, and use the diode as a circuit element for different applications.	K2,K3
CO2	To understand the working of BJT, FET and OP-amp and their application.	K2, K3, K6
CO3	To design the simple digital circuits using different logic gates.	K4, K6
CO4	To identify the errors while making electronic measurements and to understand the working of different types of transducers.	K1, K4, K5
CO5	To understand the working principle of electronic instruments and displaying it on electronic devices.	K1, K2, K4

K1- Remember, K2- Understand, K3-Apply, K4-Analyse, K5- Evaluate, K6- Create

Course Articulation Matrix (CO-PO Matrix)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	-	-	-	-	-	-	-
CO2	2	3	3	3	2	2	-	-	-	-	-	-
CO3	3	2	1	3	2	1	-	-	-	-	-	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-
CO5	3	1	3	2	1	-	-	-	-	-	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit-I:
P-N Junction Diode, Depletion layer, Barrier potential, forward and reverse bias, Knee voltage, V-I Characteristics and its Equivalent Models, Avalanche and Zener Break Down, Diode Applications as Half Wave, Full Wave & Bridge Rectifier and their comparative analysis, Clippers, Clampers, Voltage Multiplier Circuit, Zener Diode and its Applications as a voltage regulator, Varactor diode.

Unit-II:
Basic theory and operation of PNP and NPN transistors, Characteristics of Common Base, Common Emitter and Common Collector configuration, DC Biasing : Fixed Bias, Emitter Bias, voltage divider bias, Field effect transistor: JFET, Drain and Transfer characteristic, MOSFET, Introduction to Operational Amplifier and its Applications as Adder, Subtractor, Integrator, Differentiator, log antilog.

Unit-III:

Number System, Base Conversion, BCD code, Excess-3 code, Gray Code, Review of Logic Gates, Concept of Universal Gates &, Boolean laws and theorems, SOP and POS representation of Boolean functions, Minimization of Boolean functions using K map, Basic Combinational Circuits: Half Adder, Full Adder, Subtractor, Sequential Circuits: Latch, Flip-Flops, Characteristic and Excitation Table of SR, JK, D and T Flip-flop. Concept of Master Slave Flip- Flop, Shift Registers.

Unit-IV:
Functional Elements of Instruments, Classification & Characteristics, Types of Errors, Sources of Error, Dynamic Characteristics, Active and Passive Transducers: Resistive Transducers, Thermistor, Strain Gauge, Thermocouple, Differential Output Transducers, LVDT and their Characteristics.

Unit-V:
Display Devices: LCD, LED, Seven Segment Display, Alphanumeric Display, Electronic Ammeter and Voltmeter, Digital Multi-meter, Cathode Ray Oscilloscope (CRO), Digital Storage Oscilloscope (DSO)

Text Books:

5. Electronics Principles by Albert Malvino, & David Bates, 2016, Tata McGraw-Hill, Eigth Edition, ISBN- 978-0-07-337388-1
6. Electronic Devices & Circuit Theory by Boylestad, Robert & Nashelsky, 2015, Louis, Prentice Hall of India. Eleventh Edition, ISBN- 10-9332542600
7. Electronic Instrumentation and Measurements by H.S. Kalsi, 2019, Tata McGraw-Hill, Fourth Edition, ISBN-10- 9353162513
8. Digital Principles and Applications by Leach, Malvino, & Saha, 2014, Tata McGraw-Hill, 8th Edition, ISBN-10- 9789339203405

Reference Books:

4. Microelectronic Circuits by Adel Sedra, Kenneth C.(KC) Smith, Tony Chan Carusone, Vincent Gaudet, 2020, Oxford University Press, 8th Edition, ISBN-10-0190853468
5. A Course in Electrical and Electronic Measurements and Instrumentation by A K Sawhney 2021, Dhanpat Rai & sons, ISBN-10- 8177001000
6. Fundamentals of Microelectronics by Behzad Razavi, Wiley, Second Edition, ISBN-13:9781118156322

Web Links:

3. https://nptel.ac.in/courses/108101091
4. https://nptel.ac.in/courses/122106025

NCE-101/102 : INTRODUCTION TO CIVIL ENGINEERING

C[L-T-P]: 4[3-1-0]

Course Outcomes

At the end of this course students should be able to:

CO1	To understand the overview and scope of Civil Engineering and apply the fundamentals of Surveying
CO2	To understand the various types of Civil Engineeringmaterials
CO3	To understand the basic concepts of water and wastewater quality, infrastructure, and also the basics of different pollution
CO4	To understand the basics of Highways, Railways and Airport Engineering
CO5	To understand the basics of various Civil Engineering structures

Course Articulation Matrix (CO-PO Matrix)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	2	-	-	-	-	-	1
CO1	2	-	-	-	-	2	-	-	-	-	-	1
CO2	2	-	-	-	-	2	3	-	-	-	-	1
CO3	2	-	-	-	-	2	3	-	-	-	-	1
CO4	2	-	-	-	-	2	3	-	-	-	-	1
CO5	2	1	1	-	-	2	1	-	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put "-".

Course Content

Unit-1: Introduction

Civil Engineering: Overview and scope of Civil Engineering, Civil Engineering landmarks, Job opportunities in Civil Engineering

Fundamentals of Surveying: Introduction, Types of Surveying - Chain, Compass, levelling and contouring, Total Station, Introduction to Remote Sensing/ GIS/ GPS

Unit-2: Civil Engineering materials

Building materials : Bricks, Stones, Cement, Aggregate, Concrete, RCC, Steel, Timber, Tiles, lime, paint.

Highway materials: bitumen, concrete, Surkhi, sand, stone dust

Soil: Types of soil, classification of soil.

Unit-3: Environmental Engineering

Water and Wastewater Quality, Drinking Water Standards, Water infrastructure- Intake, Treatment plants, distribution system, and household plumbing. Waste waterinfrastructure- household drainage system, sewerage system, Treatment Plant, and, disposal, effluent standards. Introduction to Air Pollution, Air Quality Index, Air quality standards, Solid Waste Management- collection and segregation, Noise Pollution-standards

Unit-4: Transportation Engineering

Highway Engineering: Introduction, Model, elemental and functional classification of Transportation System, IRC classification of roads, Typical cross-section of pavements, Control system.
Railway Engineering: Types of rails, Components of permanent way, stations
Airport- Components of the airport Introduction to Docks, Harbour, and Inland waterways

Unit-5: Civil Engineering Structures

Introduction to buildings: Elements- slab, beam, column, footing

Introduction to various Civil Engineering Structures- Bridges,Retaining Wall, Tanks and Reservoirs, Hydraulic Structures-Dams, Canals, Weirs, Barrage,Industrial Structures

Textbooks

4. S.S. Bhavikatti (2010). 'Basic Civil Engineering.', 1st edition, New Age International Publishers, New Delhi
5. Sateesh Gopi (2009). 'Basic Civil Engineering.', Pearson Publishers, Delhi, India
6. Punmia, B.C., Jain, A.K. and Jain, A.K. (2003). 'Basic Civil Engineering.', Laxmi Publications, New Delhi.

Reference Books

3. An Introduction to Civil Engineering by V. Okumu, CreateSpace Independent Publishing Platform.
4. Penn M. R. and Parker P. J. "Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering" John Wiley & Sons 2011.

Web Resources

https://nptel.ac.in/courses/105106201

NCT 101: INTRODUCTION TO CHEMICAL ENGINEERING AND TECHNOLOGY

L : T: P:C
3 : 1: 0 :4

Course Objective:

The objective of the course is to impart

- Knowledge of basics concepts of microbiology and Food processing
- General introduction to Oils, fats, oleochemicals, essential oils, their sources, composition and structures. Basic concepts about paints, ingredients, functions, formulation and application of paints
- Knowledge of basic concepts of Polymer and Plastics
- Knowledge of basic concepts of chemical engineering
- Knowledge of basics of leather processing

Course Outcome

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

CO1	Understanding the basic concepts of microbiology and food processing	Understand
CO2	Understand the basic concepts about oils & paints, their ingredients and functions	Understand
CO3	Understand the basics and applications of Polymers and Plastics	Understand
CO4	Understand basics and application of chemical engineering	Understand
CO5	Understanding basics of leather processing	Understand

CO-PO Mapping

PO/ CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO1 2
CO1	3	1				1	2	1	1	2		2
CO2	3	1				1	2	1	1	2		2
CO3	3	1				1	2	1	1	2		2
CO4	3	1				1	2	1	1	2		2
CO5	3	1				1	2	1	1	2		2

Syllabus

Module 1: Introduction to Biochemical Engineering and Food Technology

Introduction to biochemical engineering. Microorganisms: Characteristics, classification, morphology, and reproduction in brief, Introduction to Food Technology: Scope of Food Technology, Overview of Food Constituents, Food Quality & Safety, Regulatory framework in India.

Module 2: Introduction to Oil and Paint

General introduction to Oils; their sources, composition, physiochemical characteristics. Fatty acids; structures nomenclature, classification and principal sources. Production and consumption pattern of various oils.

Basics concepts of paints, general ingredients & their functions. Introduction of drying oils, natural & synthetic resins, extenders & prime pigments, solvents, driers and plasticizers. General formulation of paint and basic machineries used in its manufacture. Testing and application of paint.

Module 3: Introduction to Polymer Science and Technology

Concept and definition of monomers, polymers, plastics and related chemicals, Basic properties, and types of plastic materials, Utility of plastic materials in variety of fields and their advantages over other material of construction, Global and Indian scenario of Plastic and allied industries.

Module 4: Introduction to Chemical Engineering

Introduction to Chemical Engineering, Unit Operations and Processes, Thermodynamics and Kinetics, Material and Energy Balances, Reactor Design, Piping and Instrumentation, Automation and Control, Energy Resources and Environmental Engineering, Process Safety, Operations and Troubleshooting, Career Opportunities and Challenges.

Module 5: Introduction to Leather Technology

History of Leather; Overview of Leather Sector; By-Product of Meat Industry; Biodegradable products; Hides and Skins Protein; Curing of Hide & Skins; Introduction to Leather Processing; Leather Machinery.

Suggested Readings

Module 1:

Text Books:

1. Biochemical Engineering Fundamentals by J. E. Bailey & D. F. Ollis (1987) 2nd Ed McGraw Hill International Edition.
2. Pelczar M J, Chan E C S and Krieg N R "Microbiology, 5th Edition, " Mc Graw Hill, New York (1995)
3. Food Science By Norman N. Potter, 2012

Reference Books:

1. Food Microbiology By William C. Frazier, Dennis C. Westhoff · 2004
2. The Food Safety and Standards Act,2006
3. Food Facts and Principles By N. Shakuntala Manay & M. Shadaksharaswamy

Web Links:

1. www.fssai.gov.in
2. https://egyankosh.ac.in

Module 2:

Text Books

1. Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
2. Chemistry and Technology of Oils and Fats by Prof. M. M. Chakrabarti, Allied publishers (2003)
3. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)

Reference Books:

1. Fatty Acid by K. S. Markely, Inter Science publishers (1968)
2. Organic Coating Technology, Vol. I& II; byHF Payne.
3. Outlines of Paint Technology; byWMMorgan.
4. Basics of Paint Technology(Part I& II);by Malshe & Sikchi.

Web Links:

1. https://www.youtube.com/watch?v=34IADhdkvKQ
2. https://www.youtube.com/watch?v=6j8HnaZLVL8
3. https://www.youtube.com/watch?v=KTyQ-T21XgM

Module 3:

Text Books:

1. F. W. Billmeyer; Text Book of Polymer Science; Wiley; Third edition; January 2007.
2. Vasant R. Gowariker; Polymer Science; New Age International; January 2019

Reference Books:

1. Premamoy Ghosh; Polymer Science and Technology; Tata McGraw-Hill Education, New Delhi;1990.
2. R.J. Young and P.A. Lovel; Introduction to Polymers; CRC Press; London, 2011.

Web Links:

1. Introduction to Polymer Science - https://nptel.ac.in/courses/104/105/104105124/
2. Science & Technology of Polymers - https://nptel.ac.in/courses/113/105/113105028/
3. Polymer Chemistry - https://nptel.ac.in/courses/104/105/104105039/

Module 4:

Text Books:

1. Salil K Ghosal, Siddhartha Datta, "Introduction to Chemical Engineering" Tata McGraw Hill Education Private Limited, 1993.
2. Warren Lee MacCabe Smith, Peter Harriott, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill 2005

Reference Books:

1. Maloney, James O. Perry Chemical Engineers Handbook. The McGraw-Hill Companies, Inc, 2008

Web Links:

1. https://youtu.be/WgWNQVdhE9A
2. https://www.pmu.edu/department-of-chemical-engineering/pdf/IntroductionChemicalEngineering.pdf
3. https://en.wikipedia.org/wiki/Chemical_engineering

Module 5:

Text Books:

1. Dutta. S.S., “An Introduction to the Principles of Leather Manufacture”.

Reference Books:

1. Covington T., “Tanning Chemistry: The Science of Leather”.
2. Sarkar K.T., “Theory & Practice of Leather Manufacture”.

Web Links:

1. https://youtu.be/z6QnUCc7ZCg
2. https://youtu.be/4PBRW-g01Ag
3. https://www.neratanning.com/knowledge/the-leather-making-process-step-by-step/

NWS 101 / 102 : WORKSHOP PRACTICE

C (L-T-P) : 2[0-0-4]

Course Objective: The objective of this course is to educate and impart basic knowledge of various hand tools and equipments and their use in different shops, day to day industrial work and domestic life. Students able to understand safety precautions in the workshop. Student acquires skills of application oriented task.

Course Outcome
At the end of the course the student should be able to :

CO 1	Study and practice on machine tools and their operations	K2
CO 2	Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry, black - smithy and welding work	K3
CO 3	Identify and apply suitable tools for machining processes including plain turning, step turning, taper turning, facing, thread cutting operations	K4
CO 4	Understand and practice welding and forging operations	K3
CO 5	Select the appropriate tools required for specific operation and the proper safety measure required to be taken while using different tools.	K2 , K3

K1 - Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Course Articulation Matrix (CO-PO Matrix)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO(	PO10	PO11	PO12
CO1	2	-	-	1	1	1	-	-	-	-	-	1
CO2	2	-	-	1	1	1	-	-	-	-	-	1
CO3	2	-	-	1	1	1	-	-	-	-	-	1
CO4	2	-	-	1	1	1	-	-	-	-	-	1
CO5	2	-	-	1	1	1	-	-	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation put “-”.

CO1

1. Working principle of lathe machine
2. Parts and operations on lathe machine
3. Tool geometry of single point cutting tool

CO2

1. Study and practice of different tools used in Fitting shop, Carpentry shop and Foundry shop.
2. Study and practice of different tools used in Black-smithy shop, Sheet metal shop and Welding shop.

CO3

1. Explanation and demonstration of various processes like plain turning and step turning.
2. Explanation and demonstration of various processes like taper turning and facing.
3. Explanation and demonstration of various processes like thread cutting, knurling and chamfering.

CO4

1. Classification of different welding processes with the help of flow chart.
2. Explanation and demonstration forging operations.
3. Safety precautions during actual forging and welding.

CO5

1. Selection of proper drilling tool for drilling operation.
2. Selection of proper tap for internal thread cutting operation.
3. Selection of power hacksaw blade, wood cutting cutter , snips, chisels etc.

CO6

1. Proper demonstration of safety precautions to be taken for example leather apron, leather hand gloves, welding shield etc.
2. Description of different safety tools and precautions in workshop.

Course Content

1. Carpentry Shop

Practice (I) : To prepare half lap corner joint from given pieces of mango wood.
Practice (II) : To prepare mortise and tenon joint from given pieces of mango wood.
Instructions : Description and demonstration of different tools, joints along with advanced carpentry joints, classification and definition of timber, wood seasoning, demonstration of wood working lathe and advanced power tools used in carpentry work, safety precaution during actual working.

2. Fitting and Bench working Shop

Practice (I)	:	To prepare male-female joint from given pieces of mild steel.
Practice (II)	:	To prepare practice work piece involving marking , measuring , sawing, drilling and tapping operations.
Instructions	:	Classification and description of different tools used in fitting shop e.g. marking and measuring tools , holding and supporting tools, striking tools and cutting tools etc , safety precaution during actual working.

3. Black Smithy Shop

Practice (I)	:	To prepare ‘ L ’ shape job from given piece of mild steel rod by hand forging.
Practice (II)	:	To prepare a ‘ Ring ’ from given piece of mild steel rod by hand forging.
Instructions	:	Description of various forging processes done in black-smithy work e.g. upsetting, drawing down, punching, bending, fullering etc, classification and description of different tools, equipments used in black smithy shop, safety precaution during actual working.

4. Welding Shop

Practice (I)	:	To prepare simple butt joint and lap joint by electric arc welding from given pieces of mild steel.
Practice (II)	:	To prepare simple lap joint by oxy-acetylene gas welding and gas flame cutting practice.
Instructions	:	Concept of welding, classification and explanation of various types of welding with the help of flow chart, description of different tools. Equipments required for arc welding and gas welding, demonstration of various types of flames in Oxy-acetylene gas welding, setting of current and selection of electrodes along with different welding joints, safety precaution during actual working.

5. Sheet Metal Shop

Practice (I)	:	To prepare a funnel complete with soldering from given G.I. sheet.
Practice (II)	:	To fabricate tray / tool box or electric panel box from given G.I. sheet.
Instructions	:	Classification and description of different types of tools, equipments used in sheet metal work, different types of metals used in sheet metal shop e.g. Galvanized iron, lack iron, copper, aluminum etc, concept of development of surfaces along with different types of joints in sheet metal work, safety precaution during actual working.

6. Machine Shop

Practice (I)	:	To prepare a job by plain turning, facing, step turning and chamfering operation from given mild steel rod.
Practice (II)	:	To prepare a job by taper turning, threading, knurling operations from given mild steel rod.
Instructions	:	Classification of lathe machines, different parts of lathe machine, tools and equipments used, explanation and demonstration of various operations on lathe machine, tool geometry of single point cutting tool, cutting speed, feed and depth of cut in turning, safety precaution during actual working.

7. Foundry Shop

Practice (I)	:	To prepare a mould of given pattern in Green Sand
Practice (II)	:	To prepare a mould with two step pulley with runner and riser
Instructions	:	Description and use of various foundry tools, showel, flat rammer, hand rammer, strike off bars, vent wire, trowels, hand riddle etc. Types of various moulding sands, types of patterns, pattern materials, pattern allowances, safety precautions during actual working.

Text Books

1. Elements Of Workshop Technology Vol-1, by Choudhury H S K, MPP Pvt. Ltd., 2008
2. A Course in Workshop Technology Vol I by Raghuwanshi, Dhanpat Rai & sons, 2011.
3. Workshop Practice Manual by V Kapoor, Dhanpat Rai & sons, 1998
4. Workshop Technology: Manufacturing Processes by Khurmi & Gupta, S. Chand Publications, 2008

Reference books

1-Mechanical Workshop Practice, 2/E 2nd edition, Kindle Edition, K.C.John, PHI, 2010.
2-Workshop Practice , Singh Swarn, Katson Books, 2003.
3- Workshop Practice, R.K.Rajput, 2016.
4- Workshop Practice, B.L.Juneja, Cengage Learning Publishers, 2015.

Link:

1- https://sjce.ac.in/wp-content/uploads/2018/04/Workshop-Laboratory-Manual.pdf
2- https://nptel.ac.in/courses/112107219

Year II, Semester III

NMA-201 ENGINEERING MATHEMATICS–II

L:T:P:C:
3:1:0:4

OBJECTIVE: The objective of this course is to educate the students about:

- ordinary differential equations and their applications as mathematical models.
- series solutions of ordinary differential equations and special functions.
- Laplace transform, Fourier series, differential equations, and boundary value problems.

Course Outcome: On the successful completion of the course, students will be able to

CO1	solve first and higher order ordinary differential equations.	K3, K5
CO2	find series solutions of ordinary differential equations and learn Bessel's and Legendre's function and its applications.	K1, K3
CO3	solve IVPS and BVPS using Laplace Transform.	K3, K5
CO4	find Fourier series expansion of given function and solve partial differential equations.	K3, K5
CO5	solve boundary value problems using variable separable method etc.	K2, K3

CO-PO Mapping:

CO	PO1	PO 2	P O3	PO 4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12
CO1	3	3	2	1	2	-	-	1	-	1	-	3
CO2	3	3	2	1	2	-	-	1	-	1	-	3
CO3	3	3	2	1	2	-	-	1	-	1	-	3
CO4	3	3	2	1	2	-	-	1	-	1	-	3
CO5	3	3	2	1	2	-	-	1	-	1	-	3
Averag e	3	3	2	1	2	-	-	1	-	1	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is nocorrelation, put* "- "

Detailed Syllabus:

Unit- I: Ordinary Differential Equations: 10 hours

First order ordinary differential equations, Existence and uniqueness of solutions of initial value problems, Solution of higher order linear differential equation with constant coefficients,Solution of second order differential equations by changing dependent and independent variables, Cauchy-Euler equations, Methods of diagonalization, undetermined coefficients and variation of parameters: Nonlinear equations, Linear and nonlinear models, Initial value and boundary value problems, Systems of equations. Application of differential equations as mathematical models, Models from population dynamics, Newton's Law of cooling, electriccircuit, Oscillation of spring.

Unit-II: Series Solutions of Ordinary Differential Equations & Special Functions: 8 hours

Ordinary and singular points of a differential equation, Power series solutions, Frobenius method,Bessel's and Legendre's equations and their series solutions, Properties of Legendre's polynomials and Bessel's functions, Generating functions, Fourier- Bessel series and Fourier- Legendre series expansions, Sturm-Liouville Problem and related theorems.

Unit-III: Laplace Transform: 8 hours

Laplace transform, Existence conditions and ROC, Inverse Laplace transform, Operational properties, Convolution, Unit step function, Dirac-Delta function, Periodic functions, Applications to solve IVPs and BVPs: Linear ordinary differential equations, Transfer function and control system analysis.

Unit-IV: Fourier Series and Partial Differential Equations: 8 hours

Orthogonal functions, Fourier series, existence conditions, Fourier series of even and odd functions, convergence of Fourier series, Fourier half range series, Harmonic analysis, ComplexFourier series and frequency spectrum. Development of partial differential equations and solutions, Solution of first order partial differential equations, Solutions of linear higher order partial differential equations with constant coefficients.

Unit-V: Boundary-Value Problems: 6 hours

Classification of second order partial differential equations, Derivation of heat and wave equations, solutions in rectangular coordinates by separation of variable method, solution of Laplace equation, D'Alembert's solution of wave equation, non-homogeneous equations and boundary conditions, Orthogonal series expansions, Fourier series in two dimensions, Boundary value problems in polar, cylindrical, and spherical coordinate systems and their solutions.

Books Recommended:

1. E.A. Coddington, An Introduction to Ordinary Differential Equations, Practice Hall, 1995.
2. I.N. Sneddon, Elements of Partial Differential equations, McGraw-Hill 1957.
3. Dennis G, Zill & Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.
4. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers, 42nd edition, 2013.

Reference Books:

1.R.K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House,2002.

2. Erwin Kreyszig; Advanced Engineering Mathematics, John Wiley & Sons 8th Edition.
3. H. K Das and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand publishing,1st edition, 2011.Ramana "Higher Engineering Mathematics" Tata Mc Graw-Hill, 200

NCT 201: FLUID MECHANICS & MECHANICAL OPERATIONS

L	T	P	C
3	0	2	4

Course Objectives: The objective of this course is to impart

- Knowledge of various fluid properties and their measurement devices.
- Knowledge of different types flow and flow behavior during flow of fluid through pipes.
- Knowledge of mass, energy and momentum balance in the system for interdisciplinary applications
- Knowledge of mechanical operations used in understanding fluid mechanics.

CO1	Understand the concept of viscosity and other fluid properties and their measurement.	Understand
CO2	Design the fluid flow systems by applying integral balances.	Design, Apply
CO3	Apply differential balance on fluid flow to formulate and solve the problems related to fluid flow.	Analyze, Apply, Evaluate
CO4	Apply the concept of agitation and mixing of liquids to solve problems related to particulate flow	Apply, Evaluate
CO5	Understand the principle involved in various mechanical operations.	Understand, Apply
CO6	Conduct various experiments to apply the concepts of fluid mechanics and mechanical operations.	Analyze, Understand, Apply, Evaluate

CO-PO Mapping

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**		
CO2	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**		
CO3	**3**	**3**	**3**	**2**	**1**	**-**		**-**	**-**	**-**	**-**	**2**		
CO4	**3**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**		
CO5	**3**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**		
CO6	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**1**	**3**	**3**	**3**	**3**		
Average	3	2.7	2.8	1.6	1	0	0	1	3	3	3	2.2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is no correlation, put "-"*

Syllabus

Module I (6 hours)

Definition of a fluid; Continuum hypothesis; Newtonian and non-Newtonian fluids, Fluid statics: pressure variation in a static fluid, hydrostatic forces on submerged surfaces, buoyancy, Manometers. Dimensional analysis and similitude: Buckingham Pi theorem and applications

Module II (6 hours)
Macroscopic Balances: derivation of integral balances for mass, energy and momentum; Derivation of engineering Bernoulli equation with losses, Application of macroscopic balances. Flow measurement: Orifice meter, venturimeter, Pitot tube, and Rota meter, Hydrodyanmics in environmental systems.

Module III (6 hours)
Differential balances of fluid flow: derivation of continuity and momentum (Navier-Stokes) equations for a Newtonian fluid, Boundary layer theory, Pipe flows and fittings: laminar and turbulent flows; friction factor charts, losses in fittings, Fluid transportation: Valves and Pumps.

Module IV (6 hours)
Flow through packed and fluidized beds: Flow through beds of solids, motion of particles through the fluid, Particle settling, Fluidization, minimum fluidization velocity, Mixing and Agitation- power consumption, mixing times, scale up. Application of fluidized systems for environmental remediation.

Module V (6 hours)
Properties and handling of Particulate solids. Classification of size reduction equipment: Crushers, Grinders, Ultra-fine grinders, Cutting machines and related Problems. Size reduction – Rittingers Law, Kicks law, Bonds crushing law, Work index, Problems. Different types of screening equipment in industries, Screen efficiency. Filtration: Governing equations, constant pressure operation, constant flow operation, cycle time, types of filters. Centrifuges and Cyclones: Gravity settling, centrifugal separation, cyclone separations, separation efficiency, pressure loss. Basic idea of transportation equipment's.

List of experiments

1. To determine coefficient of discharge of an venturimeter
2. To determine coefficient of discharge of an orifice meter.
3. To determine the minor losses in pipe fittings
4. To verify the Bernoulli's Theorem
5. To find critical Reynolds number for a Pipe flow,
6. To calculate reduction ratio in Jaw crusher
7. To calculate reduction ratio in crushing roll
8. To calculate critical speed of Ball mill
9. To perform differential and cumulative screen analysis

Text book:

1. Dr. R. K. Bansal, Fluid mechanics and hydraulic machines, Lakshmi Publication, Tenth edition, 2019
2. McCabe, Smith and Harriott, Unit Operations of Chemical Engineering: McGraw Hill, 7th Edition 2017
3. K. Swain, H. Patra, G. K. Roy, Mechanical operations, Mc Graw Hill, 2017

Reference:

1. Chhabra, R. P., and V. Shankar, eds. Coulson and Richardson's Chemical Engineering: Volume 1A: Fluid Flow: Fundamentals and Applications. Butterworth-Heinemann, 2017.
2. Gupta, Vijay and S. K. Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi, 2015

Web Links:
https://nptel.ac.in/courses/103102211
https://archive.nptel.ac.in/courses/103/104/103104043/

NCT 203: CHEMICAL PROCESS CALCULATION

L	T	P	C
3	0	0	3

Course Objective:

To understand and apply the basics of calculations related to material and energy flow in the processes.

Course Outcome

CO1	Demonstrate comprehensive understanding of material and energy balance equations for open and closed systems.	Remember, Understand, Apply
CO2	Select appropriate basis and conduct degree of freedom analysis for solving material and energy balance problems.	Apply, Evaluate
CO3	Make elementary flow-sheets and perform material and energy balance calculations without and with chemical reactions, and involving concepts like recycle, bypass and purge.	Analyze, Evaluate
CO4	Perform process calculations utilizing psychometric charts and steam tables.	Understand, Apply,Evaluate
CO5	Design of steady state continuous flow systems and unsteady state systems by applying simultaneous material and energy balance calculations	Design, Apply, Evaluate

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSOs**	
CO1	3	3	2	1	-	-	-	-	-	-	-	2		
CO2	3	3	3	2	-	-	-	-	-	-	-	2		
CO3	3	3	3	3	2	2	-	-	-	-	-	2		
CO4	3	3	2	2	1	-	-	-	-	-	-	2		
CO5	3	3	2	1	-	-	-	-	-	-	-	2		
Avg	3	3	2.4	1.8	1.5	2	0	0	0	0	0	2		

Syllabus

Module 1 (6 hours)

Dimensions, system of units and their conversions, Mass and volume relations, Basic stoichiometric principles, limiting and excess reactants, Degree of completion, Conversion, Ideal gas law, Dalton's Law,

Module 2 (6 hours)

Vapor pressure of liquids and solids, Vapor pressure plot (Cox chart), Vapor pressures of miscible and immiscible liquids and solutions, Raoult's Law, and Henry's Law. Humidity and saturation use of humidity charts for engineering calculations.

Module 3 (6 hours)

Material balance without chemical reactions and its application to unit operations like distillation, absorption etc.

Module 4 (6 hours)

Materialbalance with chemical reaction Recycle, bypass and purging. Yield and selectivity.

Module 5 (6 hours)

Heat capacity of gases, liquids and solutions Heat of fusion and vaporization. Steady state energy balance for systems with and without chemical reactions. Calculations and application of heat of reaction combustion, formation.

Text books

1. Hougen, O.A., Watson, K.M and Ragatz, R.A., "Chemical Process Principles Part-I", John Wiley and Asia Publishing, 2nd edition 2005.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", Prentice Hall Inc., seventh edition, 2003
3. Felder, R.M. & Rousseau, R.W. "Elementary Principles of Chemical Processes ", JohnWiley, 4th edition, 2016.

Reference Books

1. Venkataramani, V., Anantharaman, N., Begum, K. M. MeeraSheriffa, "Process Calculations", Prentice Hall of India, Second Edition, 2011.
2. Sikdar, D. C., "Chemical Process Calculations", Prentice Hall of India, 2013.

Web Links:

https://archive.nptel.ac.in/courses/102/106/102106069/

NHS201 ECONOMICS AND MANAGEMENT

L:T:P:C
3:0:0 :3

UNIT I: Introduction to Economics:

Overview: production possibility curve, choices-what, how and for whom, micro- and macroeconomics, inflation, unemployment, GDP and business cycle; demand and supply, elasticity of demand, consumer surplus and its applications

UNIT II: Production, Cost and Market:

Production function, Cost Function, Types of Market: Perfect Competition, Monopoly, Oligopoly

UNIT III: Fundamentals of Management

Development of Management Thoughts, Objectives, Functions of Management

UNIT IV: Functional Areas of Management-I

Human Resource Management: HRP, Recruitment and Selection, Performance Appraisal; Marketing Management: Functions, Strategies

UNIT V: Functional Areas of Management-II

Finance Management: Objectives, Functions; Operations Management: Concepts, Functions,Inventory Management

Text Books:

1. **Koutsoyiannis, A**., 'Modern Microeconomics', English Language Book Society, Macmillan.
2. **Joseph, L Massod,** "Essential of Management", Prentice Hall, India.
3. **S. P. Robbins,** "Management"**,** Prentice Hall, India

Additional Reference Books:

1. **Armstrong, Michel**, "A Handbook of Management Techniques", Kogan Page Limited
2. **Samuelson, Paul A** , 'Economics', 5th edition, McGraw Hill New York.
3. **Henderson, J M and Quadnt, R E** , 'Microeconomic Theory: A Mathematical Approach.', TataMacGraw Hill, New Delhi,2003

Course Outcome (COs)

1. Understand essential economic principles for solving economic problems with suitable policy alternatives.
2. Apply the knowledge of production, cost and market functions
3. Understand and apply basic functions of management
4. Develop and apply the understanding of people and marketing
5. Develop and apply the understanding of finance and operations

CO-PO Mapping

Co/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	0	0	0	0	0	0	2	1	0	0	0	2
CO2	0	0	0	0	0	0	2	1	0	0	0	2
CO3	0	0	0	0	0	0	2	1	2	2	1	2
CO4	0	0	0	0	0	0	2	1	2	2	2	2
CO5	0	0	0	0	0	0	2	1	2	2	3	2

NOT: 201 CHEMISTRY OF OILS & ALLIED PRODUCTS

L : T: P:C
3 : 1: 0 : 4

Preamble:

The course provides necessary knowledge of basic chemistry of oils and allied products, their fatty acid composition and chemical reactions. Course also provides glyceride and non-glyceride components and adulteration of other oils.

Prerequisite:

Students are required to have basic knowledge of Chemistry.

Course Outcome:

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

(CO1)	This gives exposure of various edible, non-edible, commercial oils and fats from Animal and vegetable sources including various waxes.	Understand
(CO2)	Student will be exposed to various fatty acids present in oils & fats, composition of fatty acids and glyceride & non-glyceride components.	Apply
(CO3)	This enables the students to come through the BIS specification and analyze Physical & Chemical characteristics of oils & fats.	Apply
(CO4)	Understand various chemical reactions of oils & fats and their derivatives.	Analyze
(CO5)	Apply their understanding of Chemistry of Oils & Fats to determine the adulteration of Oils & Fats and their industrial applications.	Analyze

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	1	1	3	3	1
CO2	1	2	2	1	1	3	1	1	1	1	3	1
CO3	2	3	2	2	2	2	1	3	2	2	3	1
CO4	3	3	2	2	3	3	2	2	3	3	3	1
CO5	3	3	3	3	3	3	3	3	3	3	3	1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	10	20	20
Understand	20	30	20	20
Apply	0	20	20	10
Analyze	50	20	20	40
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Classification of Oils & Fats.
2. Fatty acids compositions of Oils & Fats.
3. Production and consumption pattern of various Oils & Fats.

Course Outcome 2 (CO2)

1. Non- Glyceride components of Oils & Fats.
2. Minor constituents of Oils & Fats.
3. Waxes and their chemistry.

Course Outcome 3 (CO3)

1. Physico-chemical characteristics of Oils & Fats.
2. BIS methods for testing of oils and fats.

Course Outcome 4 (CO4)

1. Adulteration tests for vegetable and animal fats and oils and their chemistry.
2. Estimation of minor constituents of Oils & Fats.

Course Outcome 5 (CO5)

1. Chemical reactions of fats and fatty acids.
2. Industrial applications of chemical reactions.

Syllabus:

Module-I

History and general introduction

Oils, fats, waxes, mineral oils, essential oils, their sources, composition and structures. Constituents of natural fats Glycerides and fatty acids, their nomenclature, classification and principle sources; theories of glyceride structure. Production and consumption pattern of various Oils & Fats in the Country vis-à-vis world.

Module –II

Non–glyceride components

Non–glyceride components, important minor constituents and contaminants Phosphatides, sterols, gossypol, carotenoids, hydrocarbons, coloring matter, natural pigments, vitamins, antioxidants, Fatty Alcohols, Sterols, Tocopherols, Tocotrinols, Oryzanols, Triterpine Alcohols Waxes etc. Gossypol, Sesamol and Sesamoline, Flavoring compounds. Some minor important constituents of oilseeds: ricin, sinigrin, linamarine, saponin, allyl isothiocyanate, gossypol, sesamol and sesamoline; environmental contaminants.

Module– III

Physico-chemical characteristics

Physico-chemical characteristics of natural oils, fats and fatty acids Oiliness and viscosity, cloud point, titre, density and coefficient of expansion, melting point, plasticity of fats & plastic range, smoke, flash and fire

points, Boiling point; solubility and miscibility, refractive index,. Acid value, saponification value, Iodine value, thiocyanogen value, diene value, acetyl and hydroxyl value Riechert Miessel and Polensky values, and Kirshner value, Peroxide Value, Anisidine Value, Oxirane Value, TBA value, Totox value, unsaponifiable matter. BIS methods for testing of oils and fats

Module–IV

Detection of adulteration

Adulteration tests for vegetable and animal fats and oils and their chemistry Boudiens Test, Holde Test, Halphens test, Hexa Bromide Test, Ammonium Molybdate test, Test for the presence of Argemone, Sal Neem Kusum, Karanja, Animal fat, Allyl isothiocyanate test, Detection of rice bran oil in other oils and other relevant test.

Module–V

Chemical reactions of fats and fatty acids

Brief introduction to chemical reactions of fats and fatty acids Esterification, interesterification, saponification, hydrolysis: reactions involving the carboxyl groups e.g., formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc.: alkoxylation, pyrolysis: reactions in the fatty acid chain; hydrogenation, dehydrogenation, halogenation, addition of sulphur, phenols, cresols, hydrogen sulphide and mercaptans: sulphation and sulphonation and miscellaneous addition to the double bonds, Rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants

Reference Books and suggested readings:

1. Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams $4^{th\ ed}$., Chapman andHall (1964)
2. Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
3. Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, Allied publishers(2003)
4. Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)
5. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)
6. Fatty Acid by K. S. Markely, Interscience publishers (1968)
7. Treatise on fats , fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
8. Natural fatty acids and their sources by E. H. Pryde
9. BIS specifications; IS- 548, part I, II

Course Objective:

The course provides introductory knowledge of basic chemistry of oilseeds, oils & allied products. Itis a foundation course for their analysis & estimation of adulteration.

Course Outcome:

Students are well conversant with the basic knowledge of various oilseeds & oil products & exploretheir uses in further studies & in-depth knowledge of the course.

Course contents and Lecture schedule:

Module no.	Topic	No. Of lectures
1.	**History and general introduction**	
1.1	Oils, fats, waxes, mineral oils, essential oils, their sources	2
1.2	Composition and structures of oils, fats, waxes, mineral oils, essential oils.	2
1.3	Constituents of natural fats glycerides and fatty acids, their nomenclature, classification and principle sources.	2
1.4	Theories of glyceride structure.	1
1.5	Production and consumption pattern of various oils & fats in the countryvis-à-vis world.	1
2.	**Non–glyceride components, important minor constituents andcontaminants**	
2.1	Phosphatides, sterols, gossypol, carotenoids, hydrocarbons	2
2.2	Coloring matter, natural pigments, vitamins, antioxidants, fatty alcohols	2
2.3	Sterols, tocopherols, tocotrinols, oryzanols, triterpine alcohols waxes etc. Gossypol, sesamol and sesamoline, flavoring compounds	2
2.4	Some minor important constituents of oilseeds: ricin, sinigrin, linamarine, saponin, allylisothiocyanate, gossypol, sesamol and sesamoline; environmental contaminants.	2
3.	**Physico-chemical characteristics**	
3.1.	Oiliness and viscosity, cloud point, titre, density and coefficient of expansion, melting point	2
3.2.	Plasticityof fats & plastic range, smoke, flash and fire points, boiling point; solubility and miscibility, refractive index	2
3.3.	Acid value, saponification value, iodine value, thiocyanogen value, diene value, acetyl and hydroxyl value	2
3.4.	Riechert miessel and polensky values, and kirshner value, peroxide value, anisidine value	1
3.5.	Oxirane value, tba value, totox value, unsaponifiable matter. Bis methods for testing of oils and fats	1
4.	**Detection of adulteration**	
4.1.	Adulteration tests for vegetable and animal fats and oils and their chemistry boudiens test, holde test, halphens test	2
4.2.	Hexa bromide test, ammonium molybdate test, belliers turbidity test	2
4.3.	Test for the presence of argemone, sal neem kusum, karanja, animal fat	2
4.4.	Allyl isothiocyanate test, detection of rice bran oil in other oils and other relevant test	2
5.	**Chemical reactions of fats and fatty acids**	
5.1.	Brief introduction to chemical reactions of fats and fatty acids esterification, interesterification	2
5.2.	Saponification, hydrolysis: reactions involving the carboxyl groups e.g., formation of metal soaps: nitrogen derivatives, acid chlorides, anhydrides etc.	2
5.3.	Alkoxylation, pyrolysis: reactions in the fatty acid chain; hydrogenation, dehydrogenation, halogenation, addition of sulphur, phenols, cresols, hydrogen	2

	sulphide and mercaptans	
5.4.	Sulphation and sulphonation and miscellaneous addition to the double bonds, rancidity and mechanism of chemical and auto oxidation, natural & synthetic antioxidants	2
	Total	**40**

NOT: 203 SOURCES, COMPOSITION, CHARACTERIZATION OF OILS, FATS AND WAXES

L:T:P:C
3 :1:0:4

Preamble:

The course provide necessary knowledge of demand and supply scenario of oil- seed & oils its storage and handling, physical and chemical properties as well as fatty acid composition. Course also provides knowledge of natural and synthetic waxes, animal fat and marine oils and fats characteristic fatty acid composition and uses.

Prerequisite:

Students are convergent with the basic knowledge of various oil-seeds and oils, fats, waxes. They are aware of physico chemical characteristic of individual oils.

Course Outcome:

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

(CO1)	This gives exposure of various edible, non-edible, commercial oils, fats and waxes from Animal and vegetable sources.	Understand
(CO2)	Utilization of oils fats, waxes as well as storage and handling of oils and oil-seeds.	Apply
(CO3)	This enable the students to come through the specification and physical & chemical characteristic of the oil occurring naturally from vegetable/animal/marine sources	Apply
(CO4)	Apply their knowledge to analyze the application of individual oils/fats & their nutritional value for edible application direct or after modification.	Analyze
(CO5)	To analyze the characteristic and composition of various oils, fat and waxes for their nonedible & industrial purposes.	Analyze

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	2	1	2	1	2	3	3	1
CO2	1	2	2	1	1	2	2	1	2	1	3	1
CO3	2	3	2	1	2	2	1	3	2	1	3	1
CO4	3	3	2	2	3	3	2	2	3	3	3	1
CO5	3	3	2	3	2	2	2	1	3	2	3	1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	30	30	20
Apply	10	20	20	20
Analyze	40	10	20	30
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Global and national scenario of demand and supply of oil-seed and oils.
2. Imports and exports of oils and oil bearing materials.
3. Current trends and future projection.

Course Outcome 2(CO2)

1. Handling of oil seeds, oil cake and crude oil.
2. Study of storage conditions of oil-seeds.
3. BIS/Codex specification of oil, oil bearing materials.

Course Outcome 3(CO3)

1. Major edible oil seeds/oils, minor oil seeds and oils and their cultivation and utilization.
2. Utilization of non-edible oils for various industrial applications.

Course Outcome 4(CO4)

1. Milk fat and butter-the source, utilization and composition.
2. Lard, tallow and marine oils-the source, utilization and composition.
3. The production, characteristic and composition of all types of fat.

Course Outcome 5(CO5)

Composition characteristics and use:

1. Natural waxes
2. Synthetic waxes.

Syllabus:

Module-I

Handling and Storage of Oils and oilseeds

Handling of oilseeds, oil bearing materials and crude oils. Storage of oilseeds, Grading and evaluationof oilseed and oil bearing material as per BIS/ Codex, Drying of oilseed.

Module-II

Commercial oils, oilseeds, cultivation, characteristics, composition and utilization from plant sources

Coconut, palm, palm kernel, olive, cocoa butter, sunflower, safflower, sesame, groundnut, mustard, rape-seed, canola, soybean, niger seed, linseed, castor , rice-bran, cottonseed, corn, tung, Genetically modified oilseeds

Module–III

Non traditional oils and fats

Karanja, Neem. Sal Jatropha, Mango, Kernal, Nigers, Algal oil sources extraction methodology, fatty acid composition, triglycerides distribution, characteristics and industrial applications

Module-IV

Production, characteristics, composition and utilization of oils from animal sources

Milk fats and butter, lard, tallow other animal fats and greases etc. Fish and marine oils: halibut, herring, shark, menhaden, whale, sardine, fish liver oils, krill oil etc, Different methods of rendering.

Module-V

Natural and synthetic waxes characteristics, composition and utilization

Natural waxes such as bees wax, shellac wax, carnauba wax, sugarcane wax, Montana wax, jojoba wax, sperm-oil, rice bran, sunflower and spermaceti, synthetic waxes, their occurrence, classification, general properties and uses.

Text Books

Bailey's Industrial Oil and Fat Products, Volume 5, Sixth Edition Edible Oil and Fat

Reference Book

1. Products: Processing Technologies Edited by Fereidoon Shahidi, A Wiley- Interscience Publication, JOHN WILEY & SONS, New York. Oils & fats Technology Edited by E. Bernardini
2. Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams 4th ed., Chapman and Hall (1964)
3. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)
4. Fatty Acid by K. S. Markely, Interscience publishers (1968)
5. Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)

Web Links

https://www.youtube.com/watch?v=nWWA_V3bAqc
https://www.youtube.com/watch?v=BXJb6Uzvvck

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Handling and Storage of Oils and oilseeds**	
1.1	Handling of oil seeds and oil bearing material and crude oils	2
1.2	Storage of oil seeds	2
1.3	Grading and evaluation of oil seed and oil bearing material as per BIS/Codex	1
1.4	Drying of oil seeds	1
2.	**Commercial oils, oilseeds, cultivation, characteristics, composition andutilization from plant sources**	
2.1	Coco nut, palm, kernel	2
2.2	Olive, Cocoa butter, sun flower	2
2.3	Safflower, sesame, ground nut	2
2.4	Mustard rape-seeds canola, niger seed	1
2.5	Soybean, linseed, castor	1
2.6	Rice bran cotton seed, corn, tung,	2
2.7	Genetically modify oil seeds	1
3.	**Nontraditional oils and fats**	
3.1	Karanja, Neem. Sal Jatropha, Mango, Kernal, Nigers,	1
3.2	Algal oil sources extraction methodology,	1
3.3	Fatty acid composition, triglycerides distribution,	1
3.4	characteristics and industrial applications	1
4.	**Production, characteristics, composition and utilization of oils fromanimal sources**	
4.1	Milk fats and butter	1
4.2	Animal fats, lard tallow	1
4.3	Emu oil and greases	1
4.4	Fish and marine oils: halibut, herring, shark	1
4.6	Sardine oil, fish lever oils, krill oil	1
4.7	Different methods of rendering	1
5.	**Natural and synthetic waxes characteristics, composition and utilization**	
5.1	Natural waxes such as bees wax, shellac wax	1
5.2	Carnauba wax, sugar cane wax	1
5.3	Montana wax, Jojoba wax	1
5.4	Sperm oil, rice bran	1
5.5	Sunflower and spermaceti	1
5.6	Synthetic waxes their occurrence and classifications	2
5.7	General properties and uses of synthetic waxes	1
	Total	**40**

NOT: 205 OIL AND OILSEEDS ANALYSIS LAB

L:T:P:C
0:0:4 :2

Course Outcome

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

CO1	Apply laboratory methods of analysis for estimation of purity of oil	Apply
CO2	Apply laboratory techniques for determination of physical properties of oils, fats & oilseeds	Apply
CO3	Apply analytical methods for identification of oil	Apply
CO4	To identify different adulteration & to analyzed the quality of oils & fats & toapply understanding of chemistry of oils & fats & to ensure quality.	Analyze

CO3	**PO3**												**PSO3**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	1	2	1	2	1	2	2	2	2	2	2	3
CO2	1	1	1	1	1	2	2	1	1	1	2	1	2	3
CO3	3	3	3	3	2	2	1	2	2	2	2	2	1	2
CO4	2	2	1	1	1	2	2	1	1	1	2	1	2	2

- Determination of physical characteristics of oils and fats as per BIS-
  - Specific gravity
  - Refractive Index
  - Color
  - Viscosity by Ford cup and Ostwald Viscometer
  - Titre
  - Determination of Protein content
- Determination of chemical characteristics of oils and fats as per BIS-
  - Acid value
  - Saponification value
  - Iodine Value
  - Hydroxyl and acetyl Value
  - Peroxide value

Reference Books and suggested readings:

1. BIS specifications; IS- 548, part I,II & III
2. A text book of oil and fat analysis By Cocks & Reid
3. Food Lipids; Chemistry Nutrition and Biotechnology By Casimir C. Akoh & David B. Min

Web Links:

1. https://fssai.gov.in/upload/uploadfiles/files/Manual_Oil_Fat_25_05_2016(1).pdf

Year -II, Semester- IV

NCY-202: MODERN ANALYTICAL TECHNIQUES

L	T	P	C
3	1	0	4

OBJECTIVE:

The objective of this course is to make the students aware of the modern instrumental techniques, the principles underlying them and their applications in the characterization of materials.

Course outcome

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

CO1	Interpret Raman and IR–Spectra for characterization of materials.	Understand, Apply, Analyze
CO2	Interpret NMR, Mass and ESR–Spectra for characterization of materials.	Understand, Apply, Analyze
CO3	To analyze the conductivity to determine the concentration of Solution and i-E characteristics of the samples.	Understand, Apply
CO4	Analytical separation carried out by Chromatography in A multi-component system.	Remember, Apply, Analyze
CO5	Elucidation of the Thermal Stability of different molecules and their Characterization on the basis of their thermal stability and Glass Transition Temperature of Polymers. Determine the specific heat, heat of reaction, Melting point & boiling point. Check the purity of drugs, crystallization and fusion of polymeric Materials.	Understand, Apply, Evaluate, Create
CO6	To develop experimental skills to perform, monitor and manipulate the reactions.	Understand, Evaluate, Analyze

Chemistry												
BCY252	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	-	1	-	-	-	-	3

CO2	3	3	2	3	2	-	1	-	-	-	-	3
CO3	3	3	2	3	2	-	1	-	-	-	-	3
CO4	3	3	2	3	2	-	1	-	-	-	-	3
CO5	3	3	2	3	2	-	1	-	-	-	-	3
CO6	3	3	3	3	2	2	2	2	1	2	-	3
Average	3	3	2.17	3	2	0.33	1.17	0.33	0.17	0.33	-	3

1:Slight(Low)2:Moderate(Medium) 3:Substantial(High) If there is no correlation put"-".

SYLLABUS

Module I

(i) Infrared Spectroscopy: Principle, mechanics of measurements, Selection rules, fundamental vibration modes, Factors influencing the band position and intensities, some characteristic frequencies and co-relation of IR spectra with molecular structures (applications), effect of Hydrogen Bonding on vibrational frequencies.(Lectures: 5-6)

(ii) Raman Spectroscopy: Introduction theory of Raman Spectroscopy, Mechanism of Raman and Rayleigh scattering, Rule of Mutual Exclusion, correlation with the molecular structure, difference between Raman and IR spectra, Resonance Raman effect, Application of Raman Spectroscopy.
(Lecture 2-3)

(iii) Inductively coupled plasma- Introduction, Principle and applications of ICP-AES or OES.
(Lectures:2-3)

Module II

(i) Nuclear Magnetic Resonance Spectroscopy: Introduction, basic principles, mechanics of measurements, chemical shift, band multiplets, spin-spin splitting, shielding and deshielding effect, spin-spin coupling and coupling constant(J), some characteristics of NMR positions, Application in elucidation of molecular structure,,Elementary idea of NOE, DEPTNMR, C^{13}NMR, P^{31}NMR, F^{19}NMR.

(Lectures:4-5)

(ii) Mass Spectroscopy: Introduction, basic principles, instrumentation, fragmentation patterns, nitrogen rule, McLafferty Rearrangement, interpretation of mass spectra and applications.

(Lectures:3-4)

(iii) ESR(Electron Spin Resonance)-Basic Principles, Instrumentation and Applications.
(Lectures:2-3)

Module III

(i) Potentiometry and Conductometry: General principles, reference and indicator electrodes, potentiometric and conductometric titrations.

(Lectures: 3-4)

Polarography: Basic principle, dropping mercury electrode (DME), half wave potential, polarographic currents and applications.

(Lectures:3-4)

Module IV

(i) Chromatographic methods: Introduction to chromatographic methods: Paper, TLC, Column and Gas chromatography, Principles, Instrumentation, GC column, Detectors and stationary phases and applications Hyphenated techniques(GC-MS). (Lectures: 4-5)

Liquid Chromatography LC/HPLC, Column efficiency in LC, Detectors, Instrumentation, Partition/Adsorption/Ion Exchange Chromatography and applications.

(Lectures: 4-5)

Module V

(i) Thermal Methods of Analysis: Thermo gravimetric analysis, differential thermal analysis and differential scanning calorimetry and applications.(Lectures:4-5)

(ii) Electron Microscopy: Introduction and Applications of Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM). (Lectures: 2-3)

(iii) X-ray methods: Introduction and applications of XRD.(Lectures: 2-3)

NMA-204 COMPUTER ORIENTED NUMERICAL METHODS

L-T-P-C:
3-0-2-4

OBJECTIVE: The objective of this course is to provide conceptual understanding of:

- various numerical methods for solving linear and nonlinear equations.

various numerical techniques of interpolation, integration, and differentiation with their applications

- various numerical methods to solve IVP_S and BVP_S.

Course Outcome: On the successful completion of the course, students will be able to

CO1	find roots of nonlinear equations and solve systems of algebraic equations.	K1, K5
CO2	use interpolation techniques and to find numerical differentiation/ integration of data, function.	K3, K5
CO3	use numerical methods for finding solutions of ordinary differential equations, simultaneous and higher order equations.	K3, K5
CO4	learn numerical methods for finding solution of initial and boundary value problems, partial differential equations.	K1, K2
CO5	learn basic concepts of some Finite element methods.	K1, K2

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	2	3	3	1	1	1	-	-	-	-	3
CO2	3	2	3	3	1	1	1	-	-	-	-	3
CO3	3	2	3	3	1	1	1	-	-	-	-	2
CO4	3	2	3	3	1	1	1	-	-	-	-	3
CO5	3	2	3	3	1	1	1	-	-	-	-	3
Averag e	3	2	3	3	1	1	1	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) *If there is nocorrelation, put "- "*

Detailed Syllabus:

UNIT I: Nonlinear Equations and Simultaneous Linear Equations: 12 hours

Roots of nonlinear equation: Methods of solution, Order of convergence of iterative methods, Simple roots: Bisection, False position, Secant, Newton-Raphson, Chebyshev, Iteration and multi point iteration methods, Multiple roots: Newton-Raphson and Chebyshev, Complex roots: Newton-Raphson and Muller's method, System of nonlinear equations: Newton-Raphson and Iteration methods, Polynomial equations: Bairstow's method, convergence analysis of abovemethods.

Linear systems: Introduction, Direct methods, Operation count, Pivoting, Ill conditioned linear systems & condition number, Iteration methods: Jacobi, Gauss-Seidel, SOR methods, convergence conditions. Special system of equations: Thomas algorithm, Eigen value problems: Given's and Power methods.

UNIT II: Interpolation, Differentiation and Integration: 10 hours

Curve fitting: Polynomial interpolation, error, existence and uniqueness, truncation error bounds, difference operators, Newton forward and backward difference interpolations, Lagrange, Newton divided difference and iterated interpolations, Stirling and Bessel's interpolations, Spline interpolation, Least squares and Chebyshev approximations, Numerical differentiation: Methods based on interpolation, error analysis, Numerical integration: methods based on interpolations (Trapezoidal, Simpson's 1/3, Simpson's 3/8 rule), Gauss quadraturemethods, Romberg integration, error bounds and estimates.

UNIT III: Numerical Solution of Ordinary Differential Equations: 6 hours

Initial-value problems, Single step methods: Taylor's, Picard's, Euler's, Modified Euler'smethod and Runge-Kutta method (fourth order), error estimates, multi-step methods: Adam's-Bashforth and Milne's methods, convergence and stability analysis, Simultaneous and Higherorder equations: RK Fourth order method.

UNIT IV: Initial & Boundary Value Problems and Iterative Solvers: 6 hours

BVP: Shooting method and finite difference methods for ordinary differential equations, Solution of partial differential equations: Laplace, Poisson equations: standard 5- point anddiagonal 5- point formulae, Jacobi method, Gauss Seidel method (Liebmann's iterative method),Relaxation method. Solution of heat equation: Crank – Nicolson method, Solution of waveequation.

UNIT V: Finite Element Method: **6 hours**

Basic concepts, variational formulation and functional, base functions, approximations weighted residual methods: Ritz method, Galerkin method, least squares method, collocation method, Finite element and solution of simple problems and time dependent problems.

NT Lab:

Develop Programs of the following techniques in C/C++ Language:

1. To implement iterative methods to solve a nonlinear equation.
2. To implement iterative methods to solve a system of linear equations.
3. To implement Forward, Backward and Central difference interpolation formulae.
4. To implement Newton's divided difference and Lagrange's interpolation formulae.
5. To implement Numerical differentiation.
6. To implement Numerical integration using Trapezoidal, Simpson 1/3 and Simpson3/8 rules.
7. To implement single step methods to solve initial value problems.
8. To implement multi step methods to solve initial value problems.
9. Solution of Heat equations (Parabolic equations) by finite difference method.
10. Solution of Laplace equations (elliptic equations) by finite difference method.
11. Solution of wave equations (Hyperbolic equations) by finite difference method.

Books Recommended:

1. M.K. Jain, S.R.K. Iyengar & R.K. Jain, Numerical methods for Scientific and EngineeringComputation, N age International Publication.
2. S.S Sastry, Introductory Methods of Numerical Analysis, Eastern Economy Edition.
3. S. Rajsekaran, Numerical Method in Science and Engineering, Wheeler Publishing House.
4. B.S. Grewal, Numerical Method in Engineering & Science, Khanna Publisher.

Reference Books:

1. Chapra, S.C. and Canale, R.P., "Numerical Methods for Engineers", Tata McGraw –Hill.
2. Balagurusamy, E., "Numerical Methods", Tata McGraw –Hill.
3. Bradie, Brian (2006). A Friendly Introduction to Numerical Analysis. Pearson EducationIndia. Dorling Kindersley (India) Pvt. Ltd. Third Impression, 2011.
4. K. W. Morton and D. F. Mayers, Numerical Solution of Partial Differential Equations,Cambridge University Press.

NCT 202: HEAT TRANSFER OPERATIONS

L	T	P	C
3	0	0	3

Course Objective: To understand the fundamentals of heat transfer mechanisms in solids and fluids through different modes and their applications in various heat transfer equipment such as heat exchangers and evaporators etc in process industries.

Course outcomes:

CO 1.	Understand different modes of heat transfer and solving steady and unsteady heat conduction problems	Understand Analyze, Evaluate
CO 2.	Apply calculation of heat transfer by free and force convection	Apply, Analyze, Evaluate
CO 3.	Apply mechanism of radiation of heat transfer in systems used in different processing operations including solar radiation	Apply, Evaluate
CO 4.	Understand phase-change phenomena of boiling and condensation	Understand, Analyze, Evaluate
CO 5.	Design of heat exchangers and its various types and applications	Design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSOs**	
CO1	3	3	2	1	-	-	-	-	-	-	-	2		
CO2	3	3	3	2	-	-	-	-	-	-	-	2		
CO3	3	3	3	3	2			-	-	-	-	2		
CO4	3	3	2	2	1	-	-	-	-	-	-	2		
CO5	3	3	2	2	-	-	-	-	-	-	-	2		
Avg	3	3	2.4	2	1.5	0	0	0	0	0	0	2		

Syllabus:

Module 1 (6 hours)
Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation, Types of Insulating materials ,Conduction: Basic concepts of conduction in solids, liquids, gases, steady state temperature fields and one dimensional conduction without heat generation e. g. through plain walls, cylindrical and spherical surfaces, composite layers, insulation thickness, Extended surfaces, fins and their applications. Introduction to unsteady state heat transfer.

MODULE 2 (6 hours)
Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside tubes, Dimensional analysis, determination of individual and overall heat transfer coefficients.

MODULE 3 (6 hours)
Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchoff's law, solar radiations, combined heat transfer coefficients by convection and radiation.

MODULE 4 (6 hours)
Heat Transfer by phase change: Condensation of pure vapors, film wise and drop wise condensation, heat transfer in boiling liquids, boiling heat transfer coefficients, Evaporation: Elementary principles, types of evaporators, Single and multiple effect evaporators.

MODULE 5 (6 hours)
Heat exchangers: Types of heat exchangers, Principal components of a concentric tube & shell-and-tube heat exchangers, baffles, heat exchanger with multiple shell and tube passes, log-mean temperature difference, overall heat transfer coefficient, fouling factors, design of double pipe and shell and tube heat exchangers.

Text Books:

1. B. K. Dutta, Heat transfer: principles and applications. PHI Learning Pvt. Ltd., 2000.
2. C.P. Gupta, R. Prakash, Engineering Heat Transfer, Nem Chand & Bros., 2012.
3. D. Q. Kern. Process heat transfer, New York: McGraw-Hill, 1950

Reference books

1. J.P. Holman, Heat transfer. McGraw Hill Higher Education; 2010.
2. Y. A., Cengel and A. J. Ghajar, Heat and Mass Transfer Fundamentals and Applications, McGraw Hill, 5th edition, 2016.

Web Links

https://archive.nptel.ac.in/courses/103/105/103105140/

https://archive.nptel.ac.in/courses/103/101/103101137/

NCT 204: CHEMICAL ENGINEERING THERMODYNAMICS

L	T	P	C
3	1	0	4

Course Objective:

To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and predict phase equilibria.

Course outcomes:

CO1	Understand the basic laws of thermodynamics and the terminology associated with engineering thermodynamics.	Understand, Analysis
CO2	Apply the laws of thermodynamics to evaluate the work and energy required/produced in different thermodynamic processes	Apply, Evaluate
CO3	Apply the knowledge of phase equilibria in two-component and multi-component systems.	Apply, Evaluate
CO4	Analyze the thermodynamic properties of substances in gas or liquid state of ideal and real mixture	Understand, Analysis
CO5	Understand intermolecular potential and excess property behaviour of multi-component systems	Understand, Analysis

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	1	-	-	1	-	1
CO2	3	1	1	1	-	-	3	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	1
CO4	3	3	3	2	-	-	1	-	-	1	-	1
CO5	3	2	2	3	-	-	1	-	-	1	-	1
Avg.	3	2.2	1.8	1.8	-	-	1.5	0	0	1	0	1

Syllabus

Module 1 (8 hours)

Basic Concepts: Scope of thermodynamics, System & Surroundings, Properties, phase, zeroth law of thermodynamics, Temperature, Equilibrium, Reversible & Irreversible process, Work, Heat, Energy;

First Law of Thermodynamics: Joule's Experiment, Internal energy, Enthalpy, Heat capacities, Application of first law to closed & open systems; Volumetric properties of pure fluids: PVT behaviour of pure substances, Phase rule; Virial equation of state and its application: ideal gas and cubic equation of state.

Module 2 (6 hours)

Second Law of Thermodynamics: Limitations of First law of thermodynamics, second law of Thermodynamics, Kelvin–Planck statement & Clausius Statement, Heat engine and thermal efficiency, Heat pump, Refrigerator, COP, Carnot's cycle, Carnot theorems; Entropy: Clausius theorem & Clausius inequality, Principle of entropy, Entropy changes of an ideal gases, Entropy generation, Entropy balance for open systems, ideal work, and lost work, Sustainability in chemical process industry.

Module 3 (6 hours)

Thermodynamic Properties of Fluids: Residual properties, Two phase systems: Clapeyron equation, Estimation of thermodynamic properties by using graphs and tables;

Vapor-Liquid Equilibria: Nature of equilibrium, phase rule, VLE qualitative behaviour, Simple Models for VLE, VLE by Modified Raoult's law

Module 4 (6 hours)

Solution thermodynamics Theory: Fundamental property relation, Chemical potential and phase equilibria, Partial properties, Ideal gas mixture model, Fugacity, and fugacity coefficient for pure species and in solution, Ideal solution model and excess properties.

Module 5 (4 hours)

Solution thermodynamics Application: Liquid phase properties from VLE data, Models for the excess Gibbs energy, Property changes of mixing.

Text Books

1. J.M. Smith and H.C. Van Ness, Introduction to Chemical Engineering Thermodynamics, McGraw Hill International Ltd,7th Edition, 2009.
2. Y.V.C. Rao, Chemical Engineering Thermodynamics, Universities Press (India) Ltd. Hyderabad.
3. K.V. Narayanan, Chemical Engineering Thermodynamics, Prentice Hall. 2007

Reference Books

B.G. Kyle, Chemical and Process Thermodynamics, Prentice Hall. 1999 Çengel, Y.A., Boles, M.A., Kanoğlu, M., Thermodynamics: An Engineering Approach, McGraw-Hill Education, New York.

Web Links:

https://archive.nptel.ac.in/courses/103/106/103106070/

https://archive.nptel.ac.in/courses/103/101/103101004/

NOT: 202 EXPRESSION AND EXTRACTION TECHNIQUES OF OIL BEARING MATERIALS

L: T: P: C
3: 1: 0 :4

Preamble:

The subject deals with the application of preparation of oil seeds & other oil bearing materials, expression &extraction methods for the purpose of achieving better oil quality, cost effective processing and adoption of newer techniques.

Prerequisite:

Knowledge of various oil bearing materials oil seeds cakes etc.

Course Outcome:

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

(CO1)	Acquire the knowledge of various oil bearing materials, oil seeds, cakes and their processing for oil extraction the need of analytical methods for better oilcontents quality.	Understand
(CO2)	Select processes for seed preparation.	Apply
(CO3)	Select methods of recovery of oil from oil bearing material, their performances. Machines & plants used, their maintenances	Apply
(CO4)	Assess quantity and quality of extracted oil& de-oiled cake, adoption of green technologies & their impact on environment.	Analyze
(CO5)	Evaluate quality of end products viz extracted oils, de-oiled cake adopting different process and cost effectiveness.	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	2	1	2	3	3	2
CO2	3	2	3	2	2	3	2	1	2	1	3	2
CO3	2	3	3	2	2	2	1	2	2	1	3	3
CO4	3	3	2	2	3	3	2	2	3	3	3	2
CO5	3	3	2	3	3	2	3	2	3	2	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	40	30	20
Apply	20	10	20	20
Analyze	30	10	20	30
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Survey of availability of seeds.
2. Knowledge of pre-pressing processes adoption.
3. Knowledge of equipment and required.

Course Outcome 2(CO2)

1. Selection of process for seed preparation.
2. Selection of extraction method (expelling/solvent extraction).
3. Other conventional methods of extraction of oil bearing materials.

Course Outcome 3(CO3)

1. Selection of solvent required for quality production.
2. Maintenance, quality control and process cost.
3. Eco-friendly process adoption for socio economic reasons.

Course Outcome 4(CO4)

1. Selection criteria for expeller/expander/solvent extractions.
2. Estimation of solvent losses, energy consumption.
3. Analysis of expeller & solvent extracted oil and its quality.

Course Outcome 5(CO5)

1. Assessment of solvent extracted oil (quantity & quality).
2 Assessment of de-oiled cake for human feed, cattle feed and other protein concentrates.
3. Effluent treatment plant, air pollution controlled devices and green technologies.

Syllabus:

Module-I

Pre-treatments of oil bearing materials:

Cleaning, delinting (for cotton seeds), dehulling (for Castor seed), Seed structure and decortication products, pre-pressing, flaking, extrusion, pelletization, stabilization (for rice bran), etc. Plants, processes and the machinery used.

Module-II

Production of Oil by mechanical expression:

Machinery employed for expression/ mechanical extraction of oils viz. Ghanis, hydraulic presses, screw presses, low pressure and high pressure expellers, Decanter, Expander- extruder system, Processing of Palm, coconut and Castor by products.

Module-III

Production of Oil by solvent extraction:

Principle of solvent extraction, solvents and their availability, selection of solvents, availability, advantages, limitations, and properties of different solvents. Solvent extraction techniques: Batch and continuous plants and processes employed for solvent extraction of low and high oil bearing materials.

Module-IV

De-solventization of meals & miscella:

Meal Desolventizing, Toasting, Drying and Cooling, Equipments and plants employed for de-solventization of extracted meal and recovery of solvent from miscella and Vapor by distillation & Condensation, Recuperation unit, current trends, storage & detoxification of oil cakes (mustard deoiled cake), production of protein products, concentrates and isolates

Module-V

Alternative extraction processes:

Principle and comparison with conventional solvent extraction processes. Green Extraction Techniques for Natural Additives Production, Use of super critical fluid and liquefied gases for oilseed extraction and oleo stearin preparations, HCF extraction ,Aqueous extraction. Enzymatic extraction; Solvent losses and utility requirements, energy conservation. Safety & hazards, maintenance and environmental consideration of solvent extraction plants & solvent recovery systems.

Reference Book and suggested readings:

1. Bailey's Industrial Oil and Fat, Edition 6 Vol-5 (2005), Edited by FeireidoonShahidi, Wiley Interscience publication
2. Seader J. D. and Henley E. J. "Separation Process Principles", 2nd Ed. (2006),Wiley-India.
3. King C. J., "Separation Processes", Tata McGraw Hill (1982).
4. Basmadjian D., "Mass Transfer and Separation Processes: Principles andApplications", 2nd Ed. (2007), CRC.
5. Khoury F. M., "Multistage Separation Processes", 3rd Ed. (2004), CRC
6. Wankat P. C., "Separation Process Engineering", 2nd Ed. (2006), Prentice Hall.
7. Official methods of AOCS
8. Handbook of FSSAI

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Pre-treatments of oil bearing materials**	
1.1	Introduction to various oil bearing materials	1
1.2	Seed cleaning equipments(seed cleaner, de-stoner)	1
1.3	Size reduction, cooking etc.	1
1.4	Flaking operation	1
1.5	Expander, extruder, pelletizer	3
1.6	Stabilization of rice bran-various methods	1
1.7	De-hulling, De-cortication processes	1
1.8	Other Machines and Equipments	1
2.	**Production of Oil by mechanical expression**	
2.1	Ghanis for oil expression	1
2.2	Hydraulic press and power press	1
2.3	Screw presses	1
2.4	Low pressure Expellers	1
2.5	High pressure Expellers	2
2.6	Expanders	1
2.7	Extruders	1
3.	**Production of Oil by solvent extraction**	
3.1	Extraction theory	1
3.2	Various Solvents and their availability	1
3.3	Selection of solvent-merits and de-merits	1
3.4	Solvent extraction techniques	1
3.5	Batch extraction plants	1
3.6	Continuous extraction plants	3
4.	**De-solventization of meals**	
4.1	De- solventization process for meal and miscella	1
4.2	Equipments and plants required for De- solventization	3
4.3	Solvent losses and their control methods	1
4.4	Utility requirement	1
4.5	Energy conservation steps	1
4.6	Safety and environmental aspects	1
4.7	Solvent recovery systems	1
5.	**Alternative extraction processes**	
5.1	Alternative solvents for extraction	1
5.2	Comparison with conventional solvents	1
5.3	Super critical extraction	2
5.4	Oleo stearine preparations	1
5.5	Aqueous extraction	1
5.6	Enzymatic extraction	1
	Total hours	**40**

NOT: 204 ESSENTIAL OILS AND COSMETICS

L : T: P:C

3 : 0:0 :3

The essential oils are natural products obtained from various vegetables and animal sources. The subject is of importance for formulation of perfumery products fragrance and flavors. Cosmetic products are produced from natural oils, fats and essential oils.

Prerequisite:

Knowledge of basic sciences organic chemistry, oils & fats.

Course Outcome:

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

(CO1)	Understand various essential oils, their sources & grades.	Understand
(CO2)	Characterize various essential oils in various applications as per their physico-chemical properties	Analyze
(CO3)	Isolate various active components of essential oils and their recoveryby different suitable process.	Apply
(CO4)	Synthesize and formulate various perfumery materials for differentapplications.	Create
(CO5)	Formulate various cosmetic products for different applications.	Create

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	1	2	1	3	3	3	2
CO2	2	2	2	2	2	3	2	1	3	1	3	2
CO3	2	3	2	2	2	2	1	2	2	1	3	3
CO4	3	3	3	2	3	3	2	3	3	3	3	2
CO5	3	3	3	3	3	2	3	3	3	2	3	3

Assessment Pattern:

Bloom"s Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	30	20	20
Apply	20	10	20	20
Analyze	20	10	20	30
Evaluate	10	20	20	10
Create	10	10	10	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Sources and availability of raw material.
2. Classification, chemistry and structure of components.
3. Bye-products and their utilization.

Course Outcome 2(CO2)

1. Physical, Chemical and optical characteristics.
2. The modern analytical Methods such as GC, GC-MS.
3. Tools for finding adulteration.

Course Outcome 3(CO3)

1. Production of essential Oils by various methods.
2. Composition of various essential oils.

Course Outcome 4(CO4)

1. Isolation of volatile components of essential oils responsible for perfume, fragrances & flavors.
2. Production of synthetic isolates.
3. Blending of various volatile oils and isolates.

Course Outcome 5(CO5)

1. Production of various cosmetic products.
2. Production of depilatories, aroma therapeutic products and herbal products etc.
3. Plant & machinery for cosmetic products, design aspects of manufacturing plant and machinery.

Syllabus:

Module –I

Classification, Chemistry and Extraction techniques of essential oil bearing materials

Different methods of extraction of essential oils, Convention extraction techniques, Production equipment, Extraction with cold fat and hot fat, alcoholic extracts, absolute of enflurages and chassis water distillation, Steam distillation, steam and water distillation, treatment of condensate water after distillation, Extraction with volatile solvents, selection of solvent and extraction apparatus, other modern extraction techniques, Grading and standardization of essential oils.

Module -II

Physico-chemical characteristics of essential oils

Specific gravity, refractive index, optical rotation, solubility, acid value, ester value, Analysis of essential oils e.g. free alcohol, total alcohol, aldehyde and ketone content, phenol content, common adulterants and their detection, Other analytical tests of essential oils such as HPLC and Super critical Chromatography FTIR, NIR and NMR, Mass spectroscopic techniques, GC-MS.

Module -III

Production, properties and composition of important Indian essential oils

Rose, jasmine, khus, sandal wood, keora, palmarosa, lemon-grass, peppermint, lemon, spices oils, clove oil, orange oil, eucalyptus oil, natural fats and bi additives compounds etc. Antioxidants for cosmetics industry Introduction, General oxidative theory, measurement of oxidation and assessments of oxidant efficiency, choice of antioxidants and Application of antioxidants

Module -IV

Important isolates, synthetic perfumery materials and fixatives

Menthol, camphor, thymol, geraniol, citral, eugenol, terpeniol, vanillin, coumarins, musk:Natural, Synthetic & Artificial, benzyl acetate, benzyl benzoate etc, Synthesis;Esters of geraniol, citraniol & terpenols, ionones, Hydroxy citronellol etc. Castor oil based perfumery chemicals, blending of perfumes.

Module -V

Production of cosmetic products

Skin Creams: Introduction, classification of skin creams, cleansing creams, Night and massage creams, Moisturizing, vanishing and foundation creams, Pigmented foundation creams, hand creams, hand and body cream, all-purpose creams. Manufacturing, Packing and storage of, Face powders, Talcum powders, Hair oil, Hair cream & dyes, Shampoos, Tooth pastes & powders, Shaving creams, body gels Lipsticks, Nail polishes, Depilatories, aroma therapeutic products and herbal products etc; related plant and machinery**.**

Reference Book

1. Soap, Detergent & Perfume Industry, S.B Srivastava, Small Industry Research Institute, NewDelhi. Essential oils –Vol. I –V by Guenther
2. Perfume Cosmetics & Soaps Vol.-I –III by W.A. Poucher
3. Manufacture of perfumes and essence by Kalicharan
4. The essential oils book Edited by Colleen K. Dodt
5. Conditioning agent for hair and skin Edited by Randyschuller and Perry Romanowski
6. Gylcerin Edited Vol -11 (1991)by Eric Jungermann & Norman O.V. Sonntag
7. Soaps: Their chemistry & Technology by J.G. Kane
8. Soaps & detergent by K.S. Parasuram
9. Bailey‟s Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Sources, classification and chemistry of essential oil bearing materials**	
1.1	Sources from different parts of natural essential oil plants, availability,timing, etc.	2
1.2	Different methods of manufacturing essential oils from various parts andaccording to the characteristics of flowers etc.	2
1.3	Grading and standardization of essential oils	1
2.	**Physico-chemical characteristics of essential oils**	
2.1	Specific gravity, refractive index, optical rotation, solubility, acid value, esterValue	2
2.2	Analysis of essential oils e.g. free alcohol, total alcohol, aldehyde and ketoneContent	2
2.3	Phenol content, common adulterants and their detection	2
3.	**Production, properties and composition of important Indian essential oils**	
3.1	Rose, Jasmine, Khus, Sandal Wood, Keora	2
3.2	Palmarosa, Lemon-Grass, Peppermint, Lemon	2
3.3	Spices Oils, Clove Oil	2
3.4	Orange Oil, Eucalyptus Oil , Natural Fats And Bi Additives Compounds Etc	2
4.	**Important isolates, synthetic perfumery materials and fixatives**	
4.1	Menthol, Camphor, Thymol, Geraniol, Citral	2
4.2	Eugenol, Terpeniol, Vanillin, Coumarins, Musk:Natural	2
4.3	Synthetic & Artificial, Benzyl Acetate, Benzyl Benzoate Etc	2
4.4	Synthesis;Esters Of Geraniol, Citraniol & Terpenols, Ionones, Hydroxy Citronellol Etc.	2
4.5	Castor Oil Based Perfumery Chemicals, Blending Of Perfumes	2
5.	**Production of cosmetic products**	
5.1	Face creams(cold and vanishing creams), Face powders, Talcum powders,Hair oil, Hair cream & dyes	2
5.2	Shampoos, Tooth pastes & powders, Shaving creams, body gels	2
5.3	Lipsticks, Nail polishes Depilatories, aroma therapeutic products and herbal products etc.	2
5.4	Related plant and machinery for cosmetics & improvement design ofessential oils and isolates manufacturing plants.	2
Total		**38**

NOT: 206 OIL CHARACTERIZATION LAB

L:T:P:C
0:0:4:2

OBJECTIVE:

The objective of this course is to enable the students

- The course provides necessary knowledge of basic chemistry of oils and allied products. Their fatty acid composition and chemical reactions.
- Course also provide glyceride and non-glyceride components and adulteration of other oils
- Course also provides the basic knowledge of oils & Oleo chemicals

Course Outcome

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

CO1	Apply laboratory methods of analysis for estimation of purity of oil	Apply
CO2	Apply laboratory techniques for determination of physical properties of oils, fats & oilseeds	Apply
CO3	Apply analytical methods for identification of oil	Apply
CO4	To identify different adulteration & to analyzed the quality of oils & fats & to apply understanding of chemistry of oils & fats & to ensure quality.	Analyze

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	1	2	1	2	1	2	2	2	2	2	2	3
CO2	1	1	1	1	1	2	2	1	1	1	2	1	2	3
CO3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	2	1	1	1	2	2	1	1	1	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) if there is no correlation, put "-"

- Determination of physical characteristics of oils and fats as per BIS and FSSAI viz. Specific gravity, Refractive Index, Color, Viscosity by Ford cup and Ostwald Viscometer
- Chemical characteristics of oils and fats as per BIS viz. Acid value, Saponification value, Iodine Value, Hydroxyl and acetyl Value, Peroxide value
- Vanaspati product analysis- MIV, Color, FFA, Capillary slip point, Peroxide value, active Ni content, Sulphur content and Iron Content, Bleaching earth/Carbon analysis,

Reference Books and suggested readings:

1. Chemical constitutions of natural fats by T.P. Hilditch and P.N. Williams 4th ed., Chapman andHall (1964)
2. Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)
3. Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, Allied publishers(2003)
4. Analysis of fats and oils by Mehlenbacher V. C., Garrardpren (1960)
5. Nontraditional oilseeds and oils by N. V. Bringi, Oxford and IBH Co. Pvt. Ltd. (1989)

6. Fatty Acid by K. S. Markely, Interscience publishers (1968)
7. Treatise on fats , fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)
8. Natural fatty acids and their sources by E. H. Pryde
9. BIS specifications; IS- 548, part I, II and III
10. FSSAI Manual for analysis

Year -III, Semester- V

NHS 301: ENTREPRENEURSHIP

Course: B.Tech	**Branch:** All	**Year / Semester:** 3RD Year/ 3RD Sem. / 4TH Sem.
Sessional Marks:	50	**Credit:** 2
End Semester Exam:	50	**LTP:** 2 0 0

UNIT I Entrepreneurship:

Entrepreneur and manager, Growth of entrepreneurship in India, Government's policy actions towardsentrepreneurial motivation, entrepreneurship development programmes.

UNIT II Business Enterprises and Ownership Structure:

Small scale, medium scale and large scale enterprises, role of small enterprises in economicdevelopment; proprietorship, partnership, companies and co-operatives firms: their formation,

UNIT III Project Management:

Identification and selection of projects; project report: contents and formulation, project evaluation,method

UNIT IV Project Financing and Working Capital Management:

Cost of Project, Capital Structure Planning, Sources of long term financing, Working CapitalManagement

UNIT V Institutional Support and Policies:

Institutional support towards the development of entrepreneurship in India: technical consultancyorganizations (TCOs), government policies for small scale enterprises.

Text Books:

1. **Khanka, S S**. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
2. **Desai, Vasant**, ' Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.

Additional Reference Books

1. **Gupta and Srinivasan**, 'Entrepreneurial Development', S Chand & Sons, New Delhi.
2. **Ram Chandran**, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
3. **Saini, J. S**. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd
4. **Holt, Davis, '**Entrepreneurship : New Venture Creations, PHI

Course Outcomes (COs)

1. Develop understanding of basics of entrepreneurship.
2. Apply the beginner's concept, ownership and various forms
3. Identify opportunities using identification; project conceptualisation, formulation & evaluation.
4. Learn , apply and evaluate the project financing and working capital management
5. Evaluate the role of Institution support and policy framework of Government for entrepreneurshipdevelopment in India.

CO-PO Mapping

Co/PO	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**
CO1	0	0	0	0	0	0	1	1	0	0	1	2
CO2	0	0	0	0	0	0	1	1	0	0	2	2
CO3	0	0	0	0	0	0	1	1	0	0	3	2
CO4	0	0	0	0	0	0	1	1	0	0	3	2
CO5	0	0	0	0	0	0	1	1	0	0	3	2

NCT 307: MASS TRANSFER OPERATIONS

L	T	P	C
3	0	0	3

Course Objectives: The Mass Transfer Operations course aims to provide students with an understanding of the principles, processes, and equipment involved in mass transfer operations. Upon completion of the course, students should be able to:

1. Understand the fundamental principles of mass transfer, including diffusion, convection, and mass transfer coefficients.
2. Analyze mass transfer processes in various unit operations such as distillation, absorption, extraction, and drying.
3. Design and optimize mass transfer equipment such as packed and trayed columns, liquid-liquid extraction units, and drying equipment.
4. Apply mathematical models and simulations to predict and optimize mass transfer processes, including heat and mass transfer coefficients, mass transfer rates, and system performance.

Course outcomes:

CO 1	Understand the basic principles and laws of mass transfer, Calculation of rate of mass transfer	Understand & Evaluate
CO 2	Analyze the mass transfer concepts and apply them for Absorption and Distillation processes to evaluate different process parameters	Analyze, Apply & Evaluate
CO 3	Analyze the mass transfer concepts and apply them for LLE and SLE processes to evaluate different process parameters	Analyze, Apply & Evaluate
CO 4	Analyze the mass transfer concepts and apply them for Humidification and Drying processes to evaluate different process parameters	Analyze, Apply & Evaluate
CO 5	Analyze the mass transfer concepts and apply them for Adsoption, Membrane separation and Crystallization processes to evaluate different process parameters	Analyze, Apply & Evaluate

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSOs**	
CO1	3	2	2	1	-	-	-	-	-	1		1		
CO2	3	2	1	1	-	-	-	-	-	1		1		
CO3	3	2	3	2	3	-	-	-	-	1		1		
CO4	3	3	2	2	3	-	-	-	-	1		1		
CO5	3	3	3	3	2	-	-	-	-	1		1		
Avg	3	2.4	2.2	1.8	2.7	0	0	0	0	1	0	1		

Syllabus

Module I (6 hours)

Concept of Mass Transfer, Diffusion: Steady-state molecular diffusion: Fick's law of diffusion; Equimolar counter diffusion; Stagnant film diffusion, Diffusion coefficients: Film theory; Penetration theory; surface-renewal theory; film-penetration theory, Two-film theory. Concept of interphase /mass transfer, Analogies in mass transfer.

Module II (6 hours)

Absorption and Stripping: Gas-liquid equilibrium, Henry's law, Selection of solvent,calculation of number of stages and Equipments used in Absorption and Stripping

Distillation: Equilibrium diagrams for ideal and non-ideal solutions; Relative volatility, Flash Distillation-Differential distillation, McCabe Thiele method, for determining number of stages & Equipments for Distillation

Module III (6 hours)

Liquid-Liquid Extraction(LLE): Applications; Ternary liquid-liquid equilibria; Triangular graphical representation; solution of single and multistage operation. Solid-Liquid Extraction: Applications; Solid-liquid equilibrium; Equipments used for single stage and multistage continuous operations in LLE & Leaching

Module IV (6 hours)

Humidification and Dehumidification: Vapor pressure temperature curve and Fundamental concepts Drying: Solid-gas equilibrium, Definitions of moisture contents, Different modes of drying operations, Rate and mechanism of batch drying, Time of drying, Classification of Cooling Towers and Dryers

Module V (6 hours)

Adsorption: Concept and application of adsorption, Nature of adsorbents; Adsorption isotherms and adsorption hysteresis; Number of Stages and Equipment used in adsorption. Introduction to membrane separation processes, Introduction to Carbon Capture Technology, Crystallization: Concept and laws; Supersaturation, Nucleation & Crystal growth; Types of crystallization; Equipments used for crystallization.

Text Books

1. R.E. Treybal, "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, 2017.

2. B. K. Dutta, “Principles of Mass Transfer and Separation Processes”, 8th Printing, PHI Learning Private Limited, 2015

3. W. L. McCabe, J. C. Smith, P. Harriott, “Unit Operations of Chemical Engineering”, McGraw-Hill, VII International edition, 2005.

Reference Books

1. T. K., Sherwood, R. L. Pigford, and C.R. Wilke, “Mass Transfer” McGraw Hill, 1975.
2. C.J. Geankoplis, “Transport Processes and Separation Process Principles”, 4th ed., PHI Learning Private Limited, New Delhi, 2012.
3. J.D. Seader, and E.J., Henley, “Separation Process Principles”, 2nd ed., Wiley India Pvt. Ltd., New Delhi, 2013.
4. S. Foust, “Principles of Unit Operations”, 2nd Ed., Wiley, 1980.
5. P.C., Wankat “Separation Process Engineering”, Prentice Hall, III edition, 2011.

Web-Links

https://archive.nptel.ac.in/courses/103/103/103103145/

https://archive.nptel.ac.in/courses/103/103/103103154/

NCT 309: CHEMICAL REACTION ENGINEERING

L	T	P	C
3	0	0	3

Course Objective: To apply knowledge from calculus, differential equations, thermodynamics, general chemistry, and material and energy balances to solve reactor design problems, To examine reaction rate data to determine rate laws, and to use them to design chemical reactors, To simulate several types of reactors in order to choose the most appropriate reactor for a given need, To design chemical reactors with associated cooling/heating equipment.

Course Outcomes:

CO 1	To develop an understanding of the basic concepts involved in using reaction rate equations and kinetic constants	Understand, Apply
CO 2	To Perform derivations of rate equations for non-elementary reactions both in homogenous and in heterogeneous reacting systems	Apply
CO 3	To understand the role of temperature and concentration in the rate equation	Understand
CO 4	To Perform constant volume batch reactor calculations	Apply
CO 5	To Develop calculations using the integral method and applying differential method of analysis using reactions with different orders	Understand, Apply

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSOs**	
CO1	3	2	3	-	-	-	-	-	-	1	-	1		
CO2	3	3	3	1	-	-	-	-	-	1	-	1		
CO3	3	3	3	2	-	-	-	-	-	1	-	2		
CO4	3	3	1	-	2	-	-	-	-	1	-	2		
CO5	3	3	2	2	2	-	-	-	-	1	-	2		
Avg.	3	2.8	2.4	1.7	2	0	0	0	0	1	0	1.6		

Syllabus

Module I (6 hours)

Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Introduction of Arrhenius, collision, and transition theories. Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, and second, half-life period, irreversible reaction in series, auto catalytic reaction, reversible reactions.

Module II (6 hours)

Interpretation of variable volume batch reactions for zero, first and second order reactions, Space-time and state-velocity, design equation for ideal batch, steady-state continuous stirred tank, steady-state plug flow reactors for isothermal reaction.

Module III (6 hours)

Design for single reactions, Size comparison of single reactors, Multiple reactor systems, plug flow/mixed flow reactors in series and parallel, reactors of different types in series, recycle reactor, autocatalytic reactions.

Module IV (6 hours)

Introduction to multiple reactions, yield, selectivity, qualitative discussion about product distribution, optimum temperature progression. Introduction of heterogeneous catalyst preparation and kinetics. kinetics of enzyme reactions (Michaelis-Menten and Monod models).

Module V (6 hours)

Residence time distribution of fluids in vessels, State of aggregation of the flowing systems, Earliness of mixing, Role of RTD, State of Aggregation and earliness of mixing in determining reactor behavior, E, F and C curves, Conversion in Non-ideal flow reactors.

Text Book:

1. Levenspiel, O., “Chemical Reaction Engineering”, 3rd edition, John Wiley 2006.

Reference Books

1. H. Scott Folger, “Elements of Chemical Reaction Engineering” 6th Edition, Prentice Hall, 2021.
2. J. M. Smith., “Chemical Engineering Kinetics”, 3rd Edition, McGraw-Hill chemical engineering series, 1981.

Web Links

https://archive.nptel.ac.in/courses/103/103/103103153/

https://archive.nptel.ac.in/courses/103/101/103101141/

NOT: 301 TECHNOLOGIES OF SOAPS & FAT SPLITTING

L : T: P:C
3 :1:0:4

Preamble:

The course provides basic knowledge of Soaps, their raw materials and manufacturing processes apart from domestic and industrial applications. This also gives exposure of plant and machineries used for purification of raw materials, their importance, packaging and quality control.

Prerequisite:

Knowledge of various oils, fats and fatty materials for soap manufacture.

Course Outcome:

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

(CO1)	Have basic knowledge of various surface active agents, theireffectiveness and applications.	Understand
(CO2)	Select raw materials on the basis of their properties on the requirementof finished products & testing of the raw materials.	Apply
(CO3)	Select method of Soap Manufacture, builders, fillers and additives & knowledge of the plant & machinery & maintenance of the same.	Apply
(CO4)	Evaluate quality of raw materials and finished products	Evaluate
(CO5)	Preparation of laundry & toilet soap in pilot project or in laboratory Assess process for saponification and develop formulation, to make it cost effective, knowledge of pollutant produced in the industry & theirprocess.	Create

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO11	PO11	PO12
CO1	3	3	1	3	2	1	2	1	3	1	3	1
CO2	3	2	3	3	3	3	2	3	3	2	3	2
CO3	3	3	2	1	3	2	3	3	2	1	3	2
CO4	3	3	2	3	3	2	3	3	3	2	3	3
CO5	3	3	3	2	3	3	2	2	3	3	3	2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	20
Understand	10	20	20	20
Apply	20	20	20	20
Analyze	20	20	20	30
Evaluate	20	20	20	10
Create	20	10	10	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Survey of raw materials for soap manufacture.
2. Knowledge of various types of soaps and their utility.
3. Knowledge of equipments and machineries required.

Course Outcome 2(CO2)

1. Selection of process for saponification & soap manufacture.
2. Selection of builders and fillers based on required quality of end products.
3. Other conventional methods of saponification & soap manufacture.

Course Outcome 3(CO3)

1. Acquiring knowledge of types of soaps like soft soap, liquid soaps, transparent soaps,medicated soaps, floating soaps, etc.
2. Maintenance, quality control and process cost.
3. Eco-friendly process adoption.

Course Outcome 4(CO4)

1. Selection criteria for plant and machineries.
2. Estimation of process cost like energy consumption, etc.
3. Analysis of all incoming materials and final product.

Course Outcome 5(CO5)

1. Assessment of eco friendly processes of soap manufacture.
2. Modification of raw materials for better quality.
3. Effluent treatment plant, air pollution control devices and green technologies.

Syllabus:

Module-1 Fundamental of soaps

History and background of soaps, General principles of soap-making, chemistry of cleaning action in soaps. Study of saponification reaction, velocity and temperature. Raw material for soaps and their selection: role of INS factor, solubility ratio and hardness number, quality specifications and soap making properties of oils and fats.

Module-II

Modification and quality enhancement of household soaps

Selection and functions of builders, fillers and other auxiliary raw materials, Classification of builders and their specifications according to BIS, Up-gradation of raw materials including fractionation,

Manufacture of soaps from fatty acids & methyl esters, Specifications of soaps and fatty acids as per BIS standards.

Module-III

Manufacture and processing of household soaps

Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes, phase behavior, Production of soap base by traditional methods in single vessel, saponification in presence of catalysts and/or at high temperature and high pressure. Modern process and plant for the production of household and toilet soaps viz. Cascade, Mazzoni. Machinery employed and quality specifications with emphasis on effect on quality of milling and plodding, Principles related to the production of extruded soaps-solidification and high shear reaction system, drying, extrusion, solid-solid co-extrusion, homogenization and plastic working

Module-IV

Manufacture and quality specification of specialty soaps

Soft soaps, liquid soaps, carbolic soap, Jelly soap, transparent and translucent soaps, super fatted soaps, medicated soaps, herbal soaps, floating soaps, multi colored soaps etc. Soap powders like spray-chilled and spray-dried powders.

Module-V

Fat splitting and fatty acid distillation

Hydrolysis of oils and fats; composition of partially split fats. Effect of temperature, pressure, catalyst and ratio of reactants in hydrolysis of fats; degree of splitting; Plants and processes employed for fat splitting: Twitchell process, enzymatic fat splitting, low, medium and high pressure autoclave processes; semi-continuous and continuous processes of fat splitting, columns for DFA production. Fatty acid distillation, crystallization, fractionation, high purity fatty acid products blends distillation. Specifications of fatty acids and glycerin as per BIS, Recovery of glycerin from spent soap lye & sweet water.

Reference Books and suggested readings

1. M.M Chakrabarty. Chemistry and Technology of Oils and Fats. Allied Publishers Pvt. Ltd. New Delhi.
2. NIIR Board. The Complete Technology Book on Soaps (2nd Revised Edition)
3. Parasuram K. S. (2002) Soaps and Detergents. Tata Macgraw Hill. (ISBN 007-462324-9)
4. Spitz, L. (2016). Soap Manufacturing Technology: Second Edition.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Fundamentals of soaps**	

1.1	History and background of soaps, chemistry of cleaning action, General principles of soap-making	1
1.2	Raw material for soaps and their selection	2
1.3	Quality specifications and soap making properties of oils and fats	1
1.4	Selection and functions of builders, fillers and other auxiliary rawmaterials, Up gradation of raw materials including fractionation	2
2.	**Modification and quality enhancement of household soaps:**	
2.1	Classification of builders and their specifications according to BIS	1
2.2	Up-gradation of raw materials including fractionation	1
2.3	Manufacture of soaps from fatty acids & methyl esters	1
2.4	Quality specifications and soap making properties of oils and fats	2
3.	**Manufacture and processing of household soaps:**	
3.1	Production of soap base by traditional methods in single vessel	1
3.2	Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes	2
3.3	High shear reaction system	1
3.4	Modern process and plant for the production of household and toilet soaps	1
3.5	Cascade and Mazzoni processes for the production of household and toiletsoaps	1
3.6	Machinery employed for soap manufacture	1
3.7	Machinery for milling and plodding	1
3.8	Production of extruded soaps-solidification and high shear reaction system	1
3.9	Drying, extrusion, solid-solid co-extrusion	1
3.10	Homogenization and plastic working	1
4.	**Manufacture and quality specification of specialty soaps**	
4.1	Soft soaps, liquid soaps	1
4.2	carbolic soap, Jelly soap	1
4.3	Transparent and translucent soaps	1
4.4	Super fatted soaps, medicated soaps	1
4.5	Floating soaps, multi coloured soaps	1
4.6	Herbal soaps	1
4.7	Soap powders like spray-chilled and spray-dried powders	1
5.	**Fat splitting and fatty acid distillation**	
5.1	Hydrolysis of oils and fats	1
5.2	Effect of temperature, pressure, catalyst and ratio of reactants inhydrolysis of fats	1
5.3	Plants and processes employed for fat splitting	2
5.4	Twitchell process	1
5.5	Enzymatic fat splitting, low, medium and high pressure autoclaveprocesses	1
5.6	Semi-continuous and continuous processes of fat splitting	1
5.7	Fatty acid distillation, crystallization, fractionation, high purity fatty acidproducts blends distillation	1
5.8	Specifications of fatty acids and glycerin as per BIS, Recovery of glycerin from spent soap lye & sweet water	1
	Total	**38**

NOT: 303 REFINING OF OILS

L : T: P:C
3 : 1: 0:4

Preamble:

Refining of Oils is the processing of various types of oils, to enhance the oil quality to increase the shelf life, suitable for human consumption, adoption of latest and most modern technology to increase the yield and use of minimum inputs to reduce the cost of production, and processing cost using the optimum level of energy and utilities.

Prerequisite:

In depth knowledge of various process involved in the refining of oils, their quality parameters and learning techniques of latest modern technology.

Course Outcome:

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

(CO1)	Acquire the knowledge of various impurities present in different oils, the techniques of their processing, understand each and every aspects pertaining to chemical reactions involved in the processing, and understand basic concepts of unit operations in different processing steps.	Understand
(CO2)	Apply the knowledge acquired for industrial processes for refining of oil like degumming, neutralization, bleaching, de-odorisation, physical refining,fractionation, de-waxing and winterization.	Apply
(CO3)	Apply the knowledge acquired for improving efficiency of the utilities ofrefinery.	Apply
(CO4)	Analyze different refining process and select optimum process to be adoptedfor processing of different oils.	Analyze
(CO5)	Assess final end products quality, cost analysis and evaluate effective process.	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	1	2	1	3	1	3	1
CO2	3	2	3	3	3	3	2	3	3	2	3	2
CO3	3	3	2	1	3	2	3	3	2	1	3	2
CO4	3	3	3	2	3	3	2	2	3	3	3	2
CO5	3	3	2	3	3	2	3	3	3	2	3	3

Assessment Pattern:

Bloom‟s Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	30	30	20
Apply	10	20	20	20

Analyze	40	10	20	30
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Various steps of processing as per raw oil quality to be processed and kind of oil.
2. Selection of optimum technology to be adopted.
3. Knowledge of plant and machinery, their design, preventive and break downmaintenance as per process requirement.

Course Outcome 2(CO2)

1. Use of different process as per requirement.
2. Optimum dose of various chemicals at proper process conditions to have effectiveprocess control.
3. Adoption of latest process equipments as per different steps required for processing.

Course Outcome 3(CO3)

1. Control over working of different associated plants like chillers, boilers, compressors, filters etc.
2. To ensure the optimum level of waste generation and minimizing the losses at different processing steps and monitoring the same.
3. Proper knowledge of different axlillary equipments operation and maintenance.

Course Outcome 4(CO4)

1. Quality checks to monitor excellent quality of end product.
2. Use of modern techniques of analysis like G.L.C, U.V Spectro-photometer to meet out . the various specification as per process being adopted
3. Proper check with respect to the bye-products to ensure the minimum waste so as tocontrol over cost of production.

Course Outcome 5(CO5)

1. Compare the final product as per standard specifications.
2. Cost analysis to assess the position and to arrive at the correct sailing price decisionmaking
3. Control over cost of utilities and energy.

Syllabus:

Module-1

Pre-treatment of Oils:

Impurities of crude oils & micronutrients: Effect of refining and other processing on specific impurities. Washing of crude cotton seed oil, degumming of oils and fats: Mechanism of degumming, various methods

employed for degumming, Px series of separators, De-waxing of oils: Principle and methods of de-waxing of individual oils, Winterization in oils.

Module-II

De-acidification of oils and fats:

De-acidification by alkalis e.g. caustic soda and sodium carbonate; batch and continuous methods; separators, refining losses, effect of operating variables, liquid-liquid extraction, miscella refining; Zenith refining, cold refining, physical refining of oils: Batch, semi-continuous and continuous methods, principle of major types of continuous process, their merits and demerits, esterification, nano-neutralization etc. and their limitations. Treatment and disposal of gums and soap stock: Batch and continuous methods.

Module-III

Bleaching of oils and fats:

Theory of adsorption bleaching; components responsible for oil color; chemical and physical characteristics of various bleaching agents; activated bleaching earth and activated carbon and their methods of manufacture, extraction of oils from spent earth, determination of bleach ability and bleaching efficiency of adsorbents, batch and continuous methods of bleaching by adsorption; DOBI value, filtration techniques for removal of spent bleaching agents from bleached oils viz. Plate & frame filter, polish filter, pressure leaf filter, use of hydro gel & silica gel, chemical bleaching; color fixation in oils and fats.

Module-IV

Deodorization of oils and utilities:

Components responsible for odor, flavor reversion, principle of deodorization, batch and continuous methods of deodorization; effect of operating variables; deodorization losses, commercial deodorizer design, thin film deodorization, Thermic fluid heater, thermo-syphoning, vacuum systems and their applications, steam generation, cooling tower. Concept of 3-MCPDE (3-Mono Chloro Propane Diol Esters) & GE (Glycidyl esters).

Module-V

Membrane technology, Biotechnology and other separation processes of crude vegetable oils and specification of refined oils:

Degumming, de-acidification and bleaching. Fractionation of Palm Oil and other vegetable and animal oils & fats, Dry fractionation, Solvent fractionation. Study of polymorphism and its application in fractionation of oil. Biotechnology: Principle and its application in oil and fat processing, blending of oils, effect of processing on micronutrients, Nutritional significance, specifications of blended and refined oils. Specifications of oils as per FSSAI, permissible limits of Additives.

Reference Books and suggested readings:

1. Bailey‟s Industrial Oil and Fat Products, Volume 5, Sixth Edition Edible Oil and Fat Products: Processing Technologies Edited by Fereidoon Shahidi, A Wiley- Interscience Publication, JOHN WILEY & SONS, New York.
2. Gupta, M. K. 2008. Practical guide to vegetable oil processing. AOCS Press, Urbana, Illinois.
3. M.M Chakrabarty. Chemistry and Technology of Oils and Fats. Allied Publishers Pvt. Ltd. NewDelhi.
4. List, G. 2009. Bleaching and Purifying Fats and Oils Theory and Practice. AOCS Press.
5. W. Hamm, R. J. Hamilton, G. Calliauw 2013. Edible Oil Processing, Second edition, John Wiley &Sons, Ltd, UK
6. Dijkstra, A. J. (2017). About water degumming and the hydration of non-hydratable phosphatides.
   i. *European journal of lipid science and technology*, *119*(9), 1600496.
7. Pandey, R. A., Sanyal, P. B., Chattopadhyay, N., & Kaul, S. N. (2003). Treatment and reuse of wastes of a vegetable oil refinery. *Resources, Conservation and Recycling*, *37*(2), 101-117.
8. Dumont, M. J., & Narine, S. S. (2007). Soapstock and deodorizer distillates from North American vegetable oils: Review on their characterization, extraction and utilization. *Food Research International*, *40*(8), 957-974.
9. Bhosle, B. M., & Subramanian, R. (2005). New approaches in deacidification of edible oils—a review. *Journal of Food Engineering*, *69*(4), 481-494.
10. de Morais Coutinho, C., Chiu, M. C., Basso, R. C., Ribeiro, A. P. B., Gonçalves, L. A. G., & Viotto, L. A. (2009). State of art of the application of membrane technology to vegetable oils: A review. *Food Research International*, *42*(5-6), 536-550.
11. Gunawan, S., & Ju, Y. H. (2009). Vegetable oil deodorizer distillate: characterization, utilization and analysis. *Separation & Purification Reviews*, *38*(3), 207-241.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Pretreatment of oils**	
1.1	Impurities of crude oil and methods of removal	1
1.2	Degumming of oil, Mechanism of degumming	1
1.3	Various methods- water, acid, dry, enzymatic	2
1.4	Super, top, alpha, special degumming, membrane filters	2
1.5	De-waxing	1
1.6	Winterization	1
2.	**De-acidification of oils and fats**	
2.1	De-acidification-chemical method	1
2.2	Alkali-type, strength and calculation of alkali requirement	2
2.3	Equipment used viz. mixers, separators, heat exchanger	1
2.4	Refining loss calculation, utilities	1
2.5	Miscella refining	1
2.6	Zenith refining	1
2.7	Physical refining, equipments used for physical refining	1
3.	**Bleaching of oils and fats**	

3.1	Treatment and disposal of gums, soap stocks	1
3.2	Theory of adsorption, bleaching components in oils	2
3.3	Bleaching earth physical and chemical characteristics	1
3.4	Bleach ability of oils/clay	1
3.5	Batch and continuous process of bleaching	1
3.6	Filtration techniques, Utilities	1
4.	**Deodorization of oils and utilities**	
4.1	Deodorization of oils	1
4.2	Components responsible for order, flavor reversion	1
4.3	Principle, batch and continuous de-odorisers	1
4.4	Operating variables, losses, Utilities	1
4.5	Deodorizer Designs-thin films, packed column, soft column type	3
4.6	Vacuum systems and their applications, Energy conservation	1
4.7	Physical refining comparison over chemical refining	1
5.	**Membrane technology, Biotechnology and other separation processes of crude vegetable oils and specification of refined oils**	
5.1	Membrane process	1
5.2	Fractionation process	1
5.3	Water effluent treatment plant using bio technology	1
5.4	Micronutrients present in vegetable oil and effect of processing on micronutrients Nutritional significance.	1
5.5	Blending of oils; significance and specifications.	1
5.6	Specifications of oils as per FSSAI, permissible limits of additives	1
	Total	**38**

NOT: 305 ENVIRONMENTAL ASPECTS OF OILS AND ALLIEDINDUSTRIES

L:T:P:C

3 :0: 0:3

Preamble:

Environmental pollution from industrial operation is important phenomenon which needs specific attention by industries. This course has been designed to make students aware environmental aspects in industrial operation in particular oil & allied industries. The course also includes study on ISO-14000 and all other environmental management system.

Prerequisite:

Knowledge of engineering and oil processing.

Course Outcome:

(CO1)	Understand the various pollutants and their effects on global scenario as well as effects on the processing of oils and allied products.	Understand
(CO2)	Analyze various characteristics of effluent streams.	Analyze
(CO3)	Apply the best treatment option available among the various pollution control methods.	Apply
(CO4)	Apply various waste minimization options available for reduction, recovery, reuse & recycle principles.	Apply
(CO5)	Apply Pollution prevention and environment management system. Audit, different regulations & acts for air, water & solid pollution control. Procedure of lisoning work & cost of processing for the treatment of the effluents produce in the oil & allied industries.	Apply

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

Mapping with Program Outcomes

CO3	PO1	PO2	PO1	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	2	3	2	2	2	3	2
CO2	3	3	2	3	3	2	3	2	3	3	3	3
CO1	3	3	2	3	2	3	3	3	2	3	3	3
CO4	2	2	3	2	2	3	3	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	20	20	20
Apply	20	30	30	20
Analyze	30	20	20	30
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Review theories of water and air pollution.
2. Study sources and global impact of pollution and legislation to control them.
3. Study of by-product utilization.

Course Outcome 2(CO2)

1. Environmental management policy and regulations. Indian and global scenarios.
2. Scope of air and water pollution problems. Methods to control them and convert themto useful resources.
3. Economic consideration of waste disposal, generate energy and recover useful products.

Course Outcome 3(CO3)

1. Physical methods of separation of the sludge, which can be used for soap making, oil. recovery etc
2. Waste audit.
3. Assessment of quantity of effluent.

Course Outcome 4(CO4)

1. Liquid effluent treatment technology establishes the process of ETP.
2. Reduce, recycle, recover & reuse concepts.
3. Design of effluent treatment plant.

Course Outcome 5(CO5)

1. Solid biological sludge digestion.
2. Application of solid sludge.
3. Recoveries from flue gas including heat recovery.
4. Air pollution control equipment's and devices.

Syllabus:

Module-I

Industrial pollution and its impact

Magnitude of industrial waste, Legislative regulations. Recycle and reuse of waste water, recovery of by-products from industrial effluents.

Module-II

Environmental Management Policy and Regulations

Environmental policy global and Indian scenario, Sustainable development and climate change, scope of air and water pollution problems, economic considerations of waste disposal, separation and segregation of wastes, gaseous, liquid and solid waste disposal with special reference to oils and allied product processing CPCB/ state pollution control board guidelines and regulations.

Module-III

Waste Management

Pollution prevention and environment Management system ISO 14000. Waste audit, Different regulation means & acts for air, water& solid pollution control.

Module-IV

Liquid Effluent Treatment Technology

Pretreatment methods, centrifugation filtration, evaporator and concentrator, extraction and distillation, treatment of dilute waste water. Treatment requirements, neutralization liquid-solid separation, biological oxidation, plant control programme, absorption, liquid phase system, reclamation of waste water effluent and by-product recovery, ion exchange system, acid and alkali purification, continuous ion-exchange, Case studies on vegetable oil processing, soaps and detergents.

Module-V

Solid & Gas Effluent treatment

Waste gas treatment: spent earth, catalyst, fly ash boiler ash, Air pollution control by mechanical method: mechanical collectors, electrostatic precipitator, filters, wet scrubbers, vapour phase system, activated carbon. Typical air purification system.

Text Books:

1. Air Pollution Engineering, S.K.Garg, Khanna Publishers(2016), DariyaGanj, New Delhi.
2. Waste Water Engineering, Metcalf Eddy, Tata McGraw-Hill publishing Company Ltd. (1990) 2nd edition, New Delhi.

Reference Book:

1. Waste management for Sustainable Development in India by Nonita T Yap & S.K Awasthi, Tata McGraw-Hill publishing Company Ltd. New Delhi.
2. Industrial waste management study at Kanpur by S.K Awasthi & R.K.Trivedi (2001), Wisdom Publishing House.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Industrial pollution and its impact**	
1.1	Magnitude of industrial waste, Legislative regulations	3
1.2	Recycle and reuse of waste water	2
1.3	Recovery of bye-product from industrial effluents	3
2.	**Environmental Management Policy and Regulations**	
2.1	Environmental policy global and Indian scenario	2
2.2	Scope of air and water pollution problems	2
2.3	Economic considerations of waste disposal	2
2.4	Separation and segregation of wastes, gaseous, liquidand solid waste disposal with special reference to oils and allied product processing CPCB/statepollution control board guidelines and regulations	2

3.	**Waste Management**	
3.1	Pollution prevention and environment Management system ISO 14000, Waste audit	3
3.2	Quality management systems	2
3.3	Different regulation means & acts for air, water& solid pollution control	3
4.	**Liquid Effluent Treatment Technology**	
4.1	Pretreatment methods, centrifugation filtration, evaporator and concentrator, extraction and distillation	2
4.2	Treatment of dilute waste water. Treatment requirements, Neutralisation liquid-solid separation, biological oxidation	2
4.3	Plant control programme, absorption, liquid phase system	2
4.4	Reclamation of waste water effluent and by-product recovery, ion exchange system	2
4.5	Acid and alkali purification, continuous ion-exchange, Case studies on vegetable oil processing, soaps and detergents	2
5.	**Solid & Gas Effluent treatment**	
5.1	Waste gas treatment: spent earth, catalyst, fly ash boiler ash	2
5.2	Air pollution control by mechanical method: mechanical collectors, electrostatic precipitator	2
5.3	Filters, wet scrubbers, vapour phase system, activated carbon. Typical air purification system	2
	Total	**40**

NOT: 307 ANALYSIS OF SOAP AND DETERGENT PRODUCTS LAB

L:T:P:C
0:0: 6:3

1. Analysis of household washing and toilet soaps as per BIS:

(a) Moisture and volatile matter content

(b) Free alkali

(c) Total alkali

(d) Total fatty matter

(e) Sodium chloride content

(f) Glycerol content

(g) Titre of fatty acids of soaps

(h) Alcohol soluble & Insolubles

(i) Identification of fat base

2. Analysis of P2O5 content in STPP

3. Determination of Surface Tension, Interfacial Tension, CMC and Contact angle

4. Determination of Fatty Acid profile of Toilet soaps

5. Analysis of Glycerin as per BIS/AOCS Method

6. Karl-Fischer method for determination of moisture

Reference Books and suggested readings

1. Soaps: Their chemistry & Technology by J.G. Kane
2. Soaps & detergent by K.S. Parasuram
3. Bailey's Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi
4. Gylcerin Edited Vol -11 (1991)by Eric Jungermann & Norman O.V. Sonntag
5. Surfactants Series vol I- VII
6. Soap Technology By Davidson
7. Soap Technology By Elliot
8. Fatty Acid Series By Markley
9. BIS- 286

Semester- VI

NCT 302: INSTRUMENTATION & PROCESS CONTROL

L	T	P	C
3	0	2	4

Course Objective: Objective is to introduce the fundamentals of process control, controllers, stability and frequency response along with different process instruments used in chemical industries. The course will teach the students, how to obtain dynamic response of closed loop systems, stability analysis in transient and frequency domains. The course will also introduce about the instruments used for measurement of temperature, pressure, flow, level, viscosity.

CO1	Introduction to process control and controllers along with open and closed loop systems	Understand, Apply
CO2	Transient response of simple control systems	Apply, Evaluate, analyze
CO3	Concept of stability and frequency response, control system design by frequency response	Analyze, Evaluate, Design
CO4	Understand the principles involved in measurements. knowledge on different measurement methods employed in industrial process units	Understand, Apply, Evaluate, analyze
CO5	Application of different measurement devices in Chemical allied industries	Apply, evaluate , analyze
CO6	Conduct various experiments to apply the concepts of fluid mechanics and unit operations.	Apply, Evaluate , analyze

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSOs**	
CO1	3	3	2	2	1	-	-	-	-	1	-	2		
CO2	3	3	3	2	1	-	-	-	-	1	-	2		
CO3	3	3	3	3	1	-	-	-	-	-	-	2		
CO4	3	1	1	-	1	-	-	-	-	1	-	2		
CO5	3	2	1	1	1	-	-	-	-	1	-	2		
Avg	3	2.4	2	2	1	0	0	0	0	1	0	2		

Syllabus

Module 1 (6 hours)

Introduction to Process control systems, Use of Laplace & Inverse Laplace Transformation in study of Process Dynamics & Control. Dynamic Modeling of a Process, Dynamic behavior of First order system. First order systems in series, Second and higher order systems for various kind of inputs, Linearization of nonlinear systems, Transportation & Transfer Lag.

Module 2 (6 hours)

Classification of control systems, Regulator & Servo control, Feed Forward & Feed backward control, Negative & Positive Feedback Control, Controllers & Final control Elements, Reduction of Block & Signal Flow Diagrams, P, PI, PD and PID controller, Response of control system with these controllers

Module 3 (6 hours)

Concept of stability, Stability Criterion, Routh test for stability, Introduction to frequency response, Introduction to control system design by frequency response (Bode Plot, Zeigler Nichols controller settings), Introduction to Controller Tuning.

Module 4 (6 hours)

Principles of measurements and classification of process control instruments, Functional elements of an instrument, Static & Dynamic Characteristics of instruments, Transducers, Error analysis, Measurement of temperature: expansion thermometers, Resistance Thermometers, thermocouples, Thermistors, Pyrometers.

Module 5 (6 hours)

Flow measurement instruments, Concentration Measuring Instruments, Level measurement; float types-hydrostatic types, thermal effect types, electrical methods and solid level measurement. Pressure Measurement: Manometers, measurement of vacuum.

List of Experiment

1. To calibrate and study the response of bimetallic thermometer.

2. To study the response of a liquid level tank system.

3. To calibrate the P/I converter.

4. To calibrate the given manometer for level measurement.

5. To study and calibrate diaphragm control valve.

7. To study the response of first order system in series using two tank liquid level system (Non-interacting system) to step input.

8. To study the response of first order system in series using two tank liquid level system (interacting system).

9. To calibrate a thermocouple using a glass bulb thermometer.

10. To assess the accuracy of a pressure gauge with a dead weight gauge tester.

Text Books

1. Coughnour and Koppel, "Process Systems Analysis and Control", McGraw-Hill, New York, 3rd Edition, 2017.

2. George Stephanopolous, "Chemical Process Control ", Prentice-Hall of India Pvt-Ltd., New Delhi, 2015.

3 Eckman, D.P., “Industrial Instrumentation”, Wiley Eastern Ltd., New York, 1990

Reference Books:

1. Singh, S. K. , “Industrial Instrumentation and Control” , Prentice Hall of India, 2016

Web Links:

https://archive.nptel.ac.in/courses/103/105/103105064/

https://archive.nptel.ac.in/courses/103/105/103105130/

NOT: 302 ADVANCE OIL CHEMISTRY AND OLEOCHEMICALS

L : T: P :C
3 : 1: 0:4

Preamble:
Advance oil chemistry and Oleo-chemicals gives exposure of various chemicals derived from oils & fats as raw materials. The oleo chemicals are used in formulation of several industrial products.

Prerequisite:
Knowledge of oil chemistry.

Course Outcome:

(CO1)	Understand glyceride structure by different method of testing synthesis of fatty acids and glycerides.	Understand
(CO2)	Apply knowledge for derivation of oleo chemicals .	Apply
(CO3)	Find applications of various oleo-chemicals in different industries.	Apply
(CO4)	Apply knowledge of oil modification and its utilization in paint & polymer industries.	Apply
(CO5)	Synthesis bio fuels and eco-friendly surfactants. Comparison of costing with chemical process of products with bioprocess.	Create

On the successful completion the course, students will be able to.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	3	2	1	2	2	3	1	3	1
CO2	2	2	3	3	3	3	2	3	3	2	3	2
CO3	3	3	2	1	3	2	3	3	2	1	2	2
CO4	3	3	2	2	2	1	2	2	3	3	2	2
CO5	3	2	2	3	3	2	2	3	2	3	2	2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	10	20
Understand	20	30	30	20
Apply	10	20	20	20
Analyze	30	10	20	30
Evaluate	10	20	20	10
Create	10	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Advance theories of glyceride structure.
2. Methods of glyceride structure determination.
3. Synthesis of fatty acids, tri-glycerides, derivatives of fatty acids.

Course Outcome 2(CO2)

1. Mechanism of important chemical & bio-chemical reactions of fats & fatty acids.
2. Polymorphism of fats & their utilization in making industrial fat products.
3. Oleo-chemicals from various oils.
4. Utilization of by-products.

Course Outcome 3(CO3)

1. Oil derivatives & their applications for surfactant industry.
2. Oil derivatives for paint industry.
3. Oil derivatives for Polymer & textile industry.

Course Outcome 4(CO4)

1. Chemistry & application of designing oils for surface coating industry.
2. Thermal & chemical modifications for maleinised oils, epoxidized oils, boiled oils, standoils, blown oils
3. Alkylds, urethane oils, evaluation of surface coating materials.

Course Outcome 5(CO5)

1. Production of methyl esters & their application.
2. Various methods of production of bio-diesel.
3. Methyl ester sulphonate production & applications.

Syllabus:

Module-1

Glyceride structure:

Advanced theories of glyceride structure of natural fats, Determination of glyceride structure; Synthesis of glycerides; estimation of mono – di and tri glycerides. lipase hydrolysis, polymorphism of fats and fatty acid. chemical synthesis of fatty acid and their derivatives.

Module-2

Mechanism of important chemical and biochemical reaction of fats and fatty acids: Esterification, inter-esterification, isomerisation, polymorphism, dehydration, pyrolysis and oxidation of fatty acid esters and other oleo chemicals derived from fats and fatty acids, products and by products from castor oil,

production of dehydrated castor oil and turkey red oil, soybean oil, production of lecithine from soybean, neem oil, etc. industrial process for the manufacture of stearic acid

Module-3

Oil derivatives and their applications:

Production and utilizations of fatty nitriles, amines, sulphited and sulphurised oils; properties, specification, plant and processes employed. Textile chemicals, leather chemicals, polymer additives, paint additives, lubricants additives,

Module-4

Chemistry and applications of drying oils:

Modification of oils for surface coating industries, thermal and chemical modification methods; properties of modified oils, process and plants employed for their commercial production. Processes for production of malenised oils, epoxidised oils, boiled oils, stand oils blown oils, urethanes oil sand alkyds, evaluation of surface coating materials.

Module-5

Production and applications of methyl ester:

Various methods for production of methyl esters, production of biodiesel, specifications as per ASTM and BIS, sulphated and sulphonated methyl esters and their applications.

Text Book

Richard D. O'Brien "Fats and Oils: Formulating and Processing for Applications" 3rd Edition (2008) CRC Press

Reference Book

1. Moghis Ahmad "Fatty Acids: Chemistry, Synthesis, and Applications" 1st EditionAcademic Press and AOCS Press.
2. Robert Selby Morrell, H. R. Wood "The Chemistry of Drying Oils" E. Benn limited.
3. Ian P. Freeman, Sergey M. Melnikov (2015) "Margarines" **https://doi.org/10.1002/14356007.a16_145.pub2**
4. International Castor Oil Association (1992) "The Chemistry of Castor Oil and ItsDerivatives and Their Applications"

Web Links:

https://www.youtube.com/watch?v=CS0uoFTb1Xs
https://www.youtube.com/watch?v=6jU7zDm9-Jw

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Glyceride structure**	
1.1	Advanced theories of glyceride structure	2
1.2	Determination of glyceride structure	3

1.3	Synthesis of fatty acid and their derivatives	1
1.4	Estimation of mono – diglycerides	1
1.5	Polymorphism of fats and fatty acid, glycerides synthesis, reaction mechanism, oleo-chemicals, bye-products utilization	2
2.	**Mechanism of important chemical and biochemical reaction of fatsand fatty acids**	
2.1	Mechanism of designing, inter-esterification, isomerisation	1
2.2	Oxidation, saponification, important oleo-chemicals.	2
2.3	Inter-esterification	2
2.4	Polymorphism	1
2.5	Oleo-chemicals	3
2.6	Bye-products Utilization	2
3.	**Oil derivatives and their applications**	
3.1	Production and utilizations of fatty nitriles	2
3.2	Production and utilization of fatty amine	2
3.3	Sulphated and sulphurised oils	1
3.4	Textile chemicals, leather chemicals	1
3.5	Polymer additives, paint additives, lubricants additives,	2
4.	**Chemistry and applications of drying oils**	
4.1	Modification of oils for surface coating industries, thermal and chemicalmodification method	2
4.2	Properties of modified oils ,changes by heat bodying and oxidative Polymerization	1
4.3	Process of maleinised, epoxidized oils	1
4.4	Process of boiled oils, stand oils, blown oil	1
4.5	Ureathane oils, alkyds	1
4.6	Evaluation of surface coating materials	1
5.	**Production and applications of methyl ester**	
5.1	Various methods of production	2
5.2	Specifications as per STM, BIS & determination thereof	1
5.3	Sulphated & sulphonated methyl ester & their application	2
	Total	**40**

NOT:304 TECHNOLOGY OF SURFACTANTS & SYNTHETICDETERGENTS

L:T:P:C
3:0:0:3

Preamble:
The subject deals with the study of role of surface active agents, their classification, methodof production and various industrial applications. Emphasis is also laid upon the environmental impact of the detergent products. Various BIS methods adopted for evaluation of their performance is also discussed in the course.

Prerequisite:
Fundamental knowledge of fatty acid composition of oils and their chemistry.

Course Outcome:
On the successful completion of the course, students will be able to.

(CO1)	Understand the role of surface active agents in day to day life	Understand
(CO2)	Apply the knowledge acquired in professional career for serving the industry	Apply
(CO3)	Use the knowledge to establish small scale enterprises	Apply
(CO4)	Use the knowledge to develop suitable formulations of detergent products	Evaluate
(CO5)	Evaluate the performance and impact of the detergent products on the environment	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO3	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO13
CO1	2	2	3	1	2	1	2	1	2	2	3	2
CO3	3	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	2	3	2	3	2	3	2	3	3	3
CO4	2	2	3	2	2	3	2	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	20	20	20
Apply	20	20	20	20
Analyze	30	20	20	30
Evaluate	20	20	20	20
Create	0	10	10	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Definition and role of surface active agents.
2. Effect of surfactants on the interfaces
3. Bulk properties and their measurement.

Course Outcome 2(CO2)

1. Chemistry and route of synthesis of anionic surfactants and their applications
2. Chemistry and route of synthesis of cationic surfactants and their applications
3. Chemistry and route of synthesis of nonionic surfactants and their applications
4. Chemistry and route of synthesis of amphoteric surfactants and their applications

Course Outcome 3(CO3)

1. Plants and machineries for production of anionic surfactants
2. Plants and machineries for production of cationic surfactants
3. Plants and machineries for production of nonionic surfactants

Course Outcome 4(CO4)

1. Role of builders in detergent product formulations
2. Production of detergent powders
3. Production of detergent cakes

Course Outcome 5(CO5)

1. BIS analysis of detergent products
2. Environmental impact of surfactants and builders
3. Performance evaluation of detergent products

Syllabus

Module- I

Surface active agents:

Theory of surface action; effect and behavior of surface active agents on the interfaces; solid- liquid, gas-liquid, liquid-liquid and interfaces formed by three phases e.g. solid, liquid and gas and two immiscible liquids. Bulk properties of surfactant solutions and methods of their measurements: micelle properties; foaming; wetting, emulsification, dispersion; and detergency; measurement of critical micelle concentration; foaming power and foam stability, wetting power, emulsifying power, stability of dispersion and detergency.

Module –II

Classification, synthesis and applications of surfactants:

Anionic surfactants: sulfated and sulfonated surfactants e.g. sulfated oils, alkyl sulfates, alkyl ether sulfates, sulfated mono-glycerides, alkyl glyceryl ether sulfonates, sulfated derivatives alkanolamides, ester and amide sulfonates, sulfonated poly-carboxylic acid surfactants, alkyl aryl sulfonates, olefin sulfonates, methyl ester sulfonates, mahogany and petroleum sulfonates and other miscellaneous anionic surfactants. Cationic surfactants: Non-quaternary nitrogen bases e.g. amines, nitriles and their: quaternary nitrogen bases and miscellaneous cationic surfactants. Nonionic surfactants: Poly-ethoxy ethers and esters and poly-hydroxy nonionic surfactants. Amphoteric surfactants, Bio surfactants, Novel surfactants.

Module –III

Plants and manufacturing processes of surfactants:

Anionic surfactants viz. alcohol sulfates, alkyl aryl sulfonates, olefin sulfonates, sulfated and sulfonated oils, alpha methyl esters etc., non ionic surfactants viz. Poly-ethoxy ethers and esters, poly- hydroxy surfactants etc. and cationic surfactant e.g. quaternary ammonium compounds.

Module –IV

Builders, fillers and auxillary materials, production of detergent products:

Inorganic and organic builders and fillers, polymers, optical brighteners, enzymes and other performance additives used in the manufacture of synthetic detergents and their functions. Various physical forms of synthetic detergents: Solid, liquid, and non/liquid forms. Manufacture of household synthetic detergents: Plants and processes employed for manufacture of powder, liquid, cake andother forms.

Module –V

Evaluation of detergent products:

Analytical techniques employed for analysis of synthetic detergents and surfactants as per BIS Methods. Environmental impact and toxicity of surfactants. Methods for determination of efficacy of surfactants

Reference Books

1. The Handbook Of Soap Manufacture, Simmons ,W. H. and Appleton ,H. A. KindleBooks, USA.
2. Soap, Detergent & Perfume Industry,Srivastava S.B ,Small Industry ResearchInstitute,New Delhi.
3. Sulphonation Technology In The Detergent Industry, Herman W. and De Groot,Springer-Verlag New York.
4. Surface Active Agents , Goliath Company,The Gale Group, USA
5. Powdered Detergents , Showell, M. The Procter & Gamble Company, Cincinnati, Ohio,USA.
6. Synthetic Detergents,. Davidson, A.,and Mılwidsky, B.M.,John Willey Sons,New York.
7. The manufacture of glycerol,by Martin, G. Technical Press, London
8. Handbook Of Detergents, Waldhoff, H.,and Henkel K.CRC Press, USA.
9. Soap-Chemistry and Technology, Kane,J. G.,
10. The Manufacture of Soaps, Other Detergents, and Glycerine,Woollatt, Edgar,Mountainview Books, PA, U.S.A.
11. Detergent Of Speciality Surfactants,Ed, Fredil,F.E.,Marcel Dekker, Inc.New York.
12. The Handbook of Soap Manufacture, by W. H. Simmons and H. A. Appleton,
13. Handbook of Detergents,Edited by Uri Zoller,CRC Press,London.
14. BIS – IS: 4955-1978; Specification for Synthetic Detergent Powders for household use
15. Gemini Surfactants: Synthesis interfacial and Application, Handbook of Detergent; Part A, B, C, D

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Surface active agents**	
1.1	Theory of surface action; effect and behavior of surface active agents on the interfaces; solid- liquid, gas-liquid, liquid-liquid	2
1.2	Bulk properties of surfactant solutions and methods of their measurements: micelle properties, foaming, wetting, emulsification, dispersion	2
1.3	Measurement of critical micelle concentration, foaming power and foam Stability	1
1.4	Measurement of wetting power, emulsifying power, stability of dispersion and detergency	1
2.	**Classification, synthesis and applications of surfactants**	
2.1	Anionic surfactants: sulfated and sulfonated surfactants e.g. sulfated oils, alkyl sulfates, alkyl ether sulfates, sulfated mono-glycerides, alkyl glyceryl ether sulfonates, sulfated derivatives alkanolamides, ester and amide sulfonates, sulfonated poly-carboxylic acid surfactants, alkyl aryl sulfonates, olefin sulfonates, methyl ester sulfonates, mahogany and	3

	petroleumsulfonates and other miscellaneous anionic surfactants.	
2.2	Cationic surfactants: Non-quaternary nitrogen bases e.g. amines, nitriles and their: quaternary nitrogen bases and miscellaneous cationic surfactants	2
2.3	Nonionic surfactants: Poly-ethoxy ethers and esters and poly-hydroxy nonionic surfactants	2
2.4	Amphoteric surfactants,	1
2.5	Bio surfactants and Novel surfactants	2
3.	**Plants and manufacturing processes of surfactants**	
3.1	Plants and manufacturing processes of anionic surfactants viz. alcohol sulfates, alkyl aryl sulfonates, alpha olefin sulfonates, sulfated and sulfonatedoils, methyl esters sulfonatesetc	3
3.2	Plants and manufacturing processes of nonionic surfactants viz. Poly-ethoxy ethers and esters, poly-hydroxy surfactants etc	2
3.3	Plants and manufacturing processes of cationic surfactant e.g. quaternary ammonium compounds	2
4.	**Builders, fillers and auxillary materials, production of detergentproducts**	
4.1	Inorganic and organic builders and fillers used in the manufacture of synthetic detergents and their functions	2
4.2	Polymers, optical brighteners, enzymes and other performance additives used in the manufacture of synthetic detergents and their functions	2
4.3	Various physical forms of synthetic detergents: Solid, liquid, and non/liquidforms	1
4.4	Plants and processes employed for manufacture of powder, liquid, cake and other forms	2
5.	**Evaluation of detergent products**	
5.1	Analytical techniques employed for analysis of synthetic detergents as per BIS Methods	2
5.2	Analytical techniques employed for analysis of surfactants as per BIS Methods	2
5.3	Environmental impact and toxicity of surfactants	2
5.4	Methods for determination of efficacy of surfactants	2
	Total	**38**

NOT: 306 HYDROGENATION AND MODIFICATION OF OILS

L:T:P:C
3:0: 0:3

Preamble:

The course provides basic knowledge of Modification of oils for edible, non-edible and industrial applications.

Prerequisite:

Basic knowledge of chemistry of Fatty acids & tri-glycerides and their structures.

Course Outcome:

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

(CO1)	Have basic knowledge of stability in edible oils for the purpose of food application	Understand
(CO2)	Have knowledge of processes involved for hydrogenation, application of catalysts, conditions of Hydrogenation & its parameters.	Apply
(CO3)	Know other Hydrogenated products, margarine, shortening, fatty alcohols-manufacturing methods and operating parameters	Apply
(CO4)	Assess quality of Hydrogenated products for health point viz trans fatty acids etc.	Analyze
(CO5)	Have exposure for quality assessment of various hydrogenated products, stability for longer storage for food application.	Analyze

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	3	2	1	2	1	3	1	2	1
CO2	2	2	3	3	3	3	2	1	3	2	3	2
CO3	3	3	2	2	1	2	1	3	2	1	3	2
CO4	3	3	3	2	2	3	2	2	3	3	3	2
CO5	3	3	2	3	2	2	3	3	3	2	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	30	30	20
Apply	10	20	20	20
Analyze	40	10	20	30
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Requirement of hydrogenation for edible purposes.
2. Knowledge of various processes of hydrogenation.
3. Knowledge of catalysts used and its manufacture.

Course Outcome 2(CO2)

1. Production of Hydrogen through electrolysis**.**
2. Batch and continuous processes hydrogenation.
3. Exposure of manufacture of Vanaspati and similar bakery products.

Course Outcome 3(CO3)

1. Production of fatty alcohols and conversion of unsaturated fatty acids to saturated ones.
2. Exposure of pretreatment process prior to hydrogenation.
3. Exposure of filtration and re use of catalysts.

Course Outcome 4(CO4)

1. Study of effect of parameters and relevance with trans production.
2. Energy Conservation in hydrogenation process.
3. Modification process like inter-esterification, fractionation, winterization etc..

Course Outcome 5(CO5)

1. Analysis of oils, hydrogen, catalyst for the process.
2. Intermediate analysis during process.
3. Analysis of final modified products & adulteration.

Syllabus:

Module-I Hydrogenation of oils:

Principle and importance of hydrogenation, kinetics of reaction, operating variables and their effect on rate of hydrogenation, selectivity and isomer formation, trans fat replacement solutions and technology, worldwide trends & regulations.

Module-II

Hydrogenation catalysts and hydrogen production:

Hydrogenation catalysts: Theory of Catalyst structure, catalyst poisons and promoters, properties of catalyst structure, different types of catalysts employed for hydrogenation of oils and fats, methods of catalyst manufacture, regeneration of nickel catalyst, Manufacture of hydrogen: methods of production and purification, storage of hydrogen, Estimation of purity of hydrogen and oxygen gas. Hydrogen gas requirements for hydrogenation of different oils.

Module-III

Commercial plants and processes for hydrogenation of oils and fats:

Different commercial plants for hydrogenation, design of hydrogenation vessels, Filtration Techniques- Plate & frame filters, candle filters. Chilling equipment for shortening, nitrogen gas based hydrogenation plants, batch and continuous methods, loop reactors, impellers. Manufacture of salad oils and salad dressing, shortening, margarine, butter, bakery and confectionery fats, cocoa butter substitute, manufacture of industrial hard oils for e. g. rice bran and castor oil and industrial applications for soaps.

Module-IV

High-pressure hydrogenation:

Production of fatty alcohols, Conjugated hydrogenation, Hydrogenation of fatty acids: importance of operating variable and feed stock purity, commercial fatty alcohols and their industrial applications, working principles of nitrogen based filtration systems.

Module-V

Modification of oils and their applications:

Analysis of modified fats, dilatometry- theory and practice, Trans unsaturated fatty acids and polyunsaturated fatty acids in nutrition and health, Energy conservation and safety aspects in hydrogenation process, frying & stability characteristics, nutrition & health aspects, Inter-esterification, fractionation, winterization, diacylglycerols as low calorie fats.

Text Books

1.Bailey's Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi A Wiley-Interscience Publication, John Wiley & Sons, New York.

Reference Book

1. Hydrogenation of Oil & Fat Edited by H.B.W. Patterson Applied Science publishers(1983)
2. Gupta, M. K., Practical guide to vegetable oil processing. AOCS Press, 2008 Urbana,Illinois.
3. M.M Chakrabarty. Chemistry and Technology of Oils and Fats. Allied Publishers Pvt.Ltd. New Delhi.
4. Fats and oils, Formulating and Processing for Applications, 3rd Edition,2009, Richar D.O. Brien.
5. Fats and Oils Handbook, Michael Bockisch, 1st Edition, 1998, AOCS Press7. BIS 10633

Web links:

https://www.youtube.com/watch?v=ILFIIhsGNpM
https://www.youtube.com/watch?v=mGHneTFzouI

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Hydrogenation of oils**:	
1.1	Principle of hydrogenation	1
1.2	Importance of hydrogenation & its kinetics	1
1.3	Parameters And their effects on rate of hydrogenation	1
1.4	Selectivity an isomer formation	1
1.5	Trans-fat and its effect on products	1
1.6	World wide trends and regulations in hydrogenation	1
2.	**Hydrogenation catalysts and hydrogen production:**	
2.1	Hydrogenation catalysts: Theory of Catalyst structure, poisons and promoters	2
2.2	Theory of catalysis	1
2.3	Properties of catalysts structure	1
2.4	Types of catalysts employed for hydrogenation of oils and fats	1
2.5	Methods of catalyst manufacture & regeneration	1
2.6	Manufacture of hydrogen gas	1
2.7	Hydrogen distribution through manifold & direct gasification	1
2.8	Estimation of purity of hydrogen and oxygen gas	1
2.9	Hydrogen gas requirements for hydrogenation of different oils	1
3.	**Commercial plants and processes for hydrogenation of oils:**	
3.1	Commercial plants for hydrogenation	1
3.2	Design of hydrogenation vessels	1
3.3	Filtration Techniques- Plate & frame filters, candle filters	1
3.4	Chilling equipment for shortening	1
3.5	Nitrogen gas based hydrogenation plants.	1
3.6	Batch and continuous methods, Loop reactors, impellers	1
3.7	Manufacture of salad oils and salad dressing	1
3.8	Shortening, margarine, butter, bakery and confectionery fats	1
3.9	Cocoa butter substitute	1
3.10	Hard oils for industrial applications	1
4.	**High-pressure hydrogenation:**	
4.1	Production of fatty alcohols Conjugated hydrogenation,	2
4.2	Hydrogenation of fatty acids	2
4.3	Commercial fatty alcohols and their industrial applications	2
5.	**Modification of oils and their applications:**	
5.1	Analysis of modified fats	1
5.2	Dilatometry- theory and practice	1
5.3	Trans, unsaturated fatty acids and polyunsaturated fatty acids in nutrition and health	1
5.4	Energy conservation and safety aspects in hydrogenation process	1
5.5	Frying & stability characteristics, nutrition & health aspects	1
5.6	Inter esterification as low calorie fats	1
5.7	Fractionation, winterization as low calorie fats	1
5.8	Diacylglycerols as low calorie fats	1
	Total hours	**40**

NOT:308 DETERGENT PRODUCT PREPARATION AND FORMULATION LAB

L:T:P:C
0 : 0:6:3

1. Laboratory preparation for the following:

(i) Metallic soaps

(ii) Turkey Red Oil

(iii) Pilot scale manufacture of Toilet soaps

2. Laboratory preparation for the following:

1. Cold Creams

2. Vanishing Creams

3. Tooth Pastes

4. Tooth Powders

5. Face Powders

6. Talcum Powders

7. Hair Oils

8. Preparation of Shampoos

Reference Books and suggested readings

1. Soaps: Their chemistry & Technology by J.G. Kane

2.Soaps & detergent by K.S. Parasuram

3. Bailey's Industrial Oil and Fat, Edition 6 Vol-6 (2005), Edited by Feireidoon Shahidi

Programme Elective Course I
NCT 322: Process Equipment Design

L T P C
3 0 0 3

Course Objective: The objective of this course is to acquire basic understanding of design parameters, complete knowledge of configuration and design procedures for commonly used process equipment in important operations.

Course Outcomes:

CO1	Understand the basics of process equipment design and important parameters of equipment design	Understand, Apply
CO2	Design internal pressure vessels and external pressure vessels.	Evaluate , Apply
CO3	Analyze, synthesize and design processes for process heat exchangers.	Understand, Apply, Evaluate
CO4	Integrate and apply techniques and knowledge acquired to design distillation	Analyze, Apply, Evaluate
CO5	Design of storage tanks, other important equipments : evaporator	Analyze, Apply, Evaluate

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	3	-	-	1	1	-	2
CO2	3	3	3	2	3	3	-	-	1	-	-	2
CO3	3	3	3	2	3	1	-	-	1	-	-	3
CO4	3	3	3	2	3	1	-	-	1	-	-	3
CO5	3	3	3	2	3	1	-	-	1	-	-	3
Avg	3	2.8	2.8	1.8	3	1.8	0	0	1	1	0	2.6

Syllabus

Module-I:

Introduction to Equipment Design Introduction: Classification of engineering materials, engineering properties of Ferrous metals, Non ferrous metals, alloys & Ceramic materials Structure-Property relationship in materials. Deformation of Materials Fracture: Elastic deformation, Plastic deformation, Creep. Corrosion And Prevention: Direct Corrosion, electro-chemical corrosion, Galvanic cells, High temperature corrosion, Passivity, factor influencing corrosion rate, Control and of corrosion-modification of corrosive environment, Inhibitors, Cathodic protection, protective coatings. Corrosion charts, Metal forming & Metal joining techniques – Different types

Module-II:

Type of pressure vessels, Thin cylinder theory for internal pressure. Code & standard for pressure vessels (IS:2825: 1969), Design considerations, classification of pressure vessels as per codes, design of cylindrical and spherical shells under internal and external pressure, selection and design of heads such for pressure vessel**.**

Module-III

Introduction, Basic design procedure and theory, Heat exchanger analysis: the effectiveness NTU method, Overall heat-transfer coefficient, Fouling factors (dirt factors), Shell and tube exchangers: construction details, Tubes, Shells, Tubesheet layout (tube count), Shell types (passes), Shell and tube designation, Baffles, Support plates and tie rods, Tube sheets (plates), Shell and header nozzles (branches), Design methods, Kern's method, Bell's method, Shell and bundle geometry, Effect of fouling on pressure drop, Pressure-drop limitations.

Module-IV

Design methods for binary distillation systems, Basic equations, McCabe-Thiele method, The Smoker equations, Batch distillation, Steam distillation, Plate efficiency, Prediction of plate efficiency. Approximate column sizing, Plate contactors, Selection of plate type, Plate-design procedure.

Module-V

Storage Tanks: Introduction and Classification of storage tanks; Design of storage tanks and few other important equipments: Evaporator, Dryer, Centrifuge etc

Text Books

1. L. E. Brownell and E. H. Young, "Process Equipment Design", Wiley, 2004.
2. B. C., Bhattacharya "Introduction of Chemical Equipment Design", CBS Publishers, 2003.
3. D.Q., Kern, Process Heat Transfer, International Student Edition, McGraw Hill, 2002.
4. R.E. Treybal, "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, 2017.

Reference Books

1.M.V. Joshi "Process Equipment Design 2/e", Macmillan India, 1981(reprint 1985).
2. E. E. Ludwig, "Applied Process Design for Chemical and Petrochemical Plants", Vol. 2, 3rd Ed., Gulf Publishers. 1997

Web Links:

https://archive.nptel.ac.in/courses/103/107/103107207/
https://archive.nptel.ac.in/courses/103/105/103105210/

NCT 324: PROCESS MODELING AND SIMULATION

L	T	P	C
3	0	0	3

Course Objective:

This course explores the basic concepts and steady state equations of simple systems in chemical process industries. It deals with the techniques for derivation of system model equations, data analysis and visualization. The course aims to present the basic idea and concept on process model with detailed analysis and solution of model equations for steady operation.

Course Outcomes:

CO1	Understand create and analyze the conservation principles, classification of models and numerical methods	Understand, & Analyze
CO2	Understand, analyze & evaluate the degree of freedom, system design variables, and flow of information in system	Understand, Analyze & evaluate
CO3	Apply the concepts to analyze and create models giving rise to nonlinear algebraic equation (NAE) systems based upon input and output data.	Apply, Analyze & Design
CO4	Apply the concepts to analyze and create models giving rise to Differential Algebraic Equations (DAEs) & Partial Differential Equations (PDEs) systems based upon input and output data.	Apply, Analyze, Evaluate, Design
CO5	Develop simulation approaches based on the concepts to solve the model equations (ANE, DAE & PDEs)	Apply, Analyze,Evaluate

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSOs**	
CO1	3	3	3	3	2	-	-	1	-	1	1	2		
CO2	3	3	3	3	3	-	-	1	-	1	1	2		
CO3	3	3	3	2	3	-	-	1	-	1	1	2		
CO4	3	3	3	2	2	-	-	1	-	1	1	2		
CO5	3	3	3	3	3	-	-	1	-	1	2	3		
Avg	3	3	3	2.6	2.6	-	-	1	-	1	1.2	2.2		

Syllabus

Module I (6 hours)

Introduction to mathematical modeling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes; Classification of models: Linear vs. Non-linear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODE-BVP.

Module II (6 hours)

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.

Module III (6 hours)

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc. Review of solution strategies for nonlinear algebraic equation (NAE).

Module IV (6 hours)

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based approaches for staged processes; Modeling of differential contactors-distributed parameter models of packed bed; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs) & Partial Differential Equations (PDEs).

Module V (6 hours)

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation software and their applications. Review of available numerical software libraries.

Text Books

[1] A. K. Jana, “Chemical Process Modelling and Computer Simulation”, PHI, 2011.

[2] Asghar Hussain, “Chemical Process Simulation”, Wiley Eastern Ltd., New Delhi, 1986.

[3] M.M. Denn, “Process Modelling”, Wiley, New York, 1990.

Reference Books

[1] C.D. Holland, “Fundamentals of Modelling Separation Processes”, Prentice Hall, (1975)

[2] D. F. Rudd and C. C. Watson, “Strategy of Process Engineering”, Wiley international, 1971

[3] W.L., Luyben “Process Modeling, Simulation, and Control for Chemical Engineering”, Mc Graw Hill.

Web Links

https://archive.nptel.ac.in/courses/103/107/103107096/

NCT 326: Process Optimization

L	T	P	C
3	0	0	3

Course Objective

The primary goal of this course is to provide an overview of state-of-the-art optimization algorithms, and the theoretical principles that underpin them, and to provide students with the modeling skills necessary to describe and formulate optimization problems and their use for solving several types of practically relevant optimization problems arising in process systems engineering.

Course Outcomes:

CO1	To identify different types of optimization problems	Understand, Apply
CO2	To explain different optimization techniques	Apply, Evaluate
CO3	To solve various multivariable optimization problems	Analyze, Evaluate
CO4	To solve problems by using Linear Programming	Apply, Evaluate
CO5	To solve optimization problems of staged and discrete processes, understand the concept of specialized & Non-traditional Algorithm	Understand, Apply, Evaluate

Table: Correlation of POs, PSOs v/s COs

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	3	1	2	2	1	-	-	1	3	-	-	2	
CO2	3	3	3	3	2	-	-	1	3	-	-	2	
CO3	3	3	3	3	3	-	-	1	3	-	-	2	
CO4	2	3	3	1	3	-	-	1	2	-	-	2	
CO5	2	3	3	1	2	-	-	1	1	-	-	3	
Average	2.6	2.6	2.8	2	2.2	-	-	1	2.4	-	-	2.2	

Syllabus

Module 1 (6 hours) Introduction to process optimization; formulation of various process optimization problems and their classification. Basic concepts of optimization-convex and concave functions, necessary and sufficient conditions for stationary points.

Module 2 (6 hours) Optimization of one- dimensional functions, unconstrained multivariable optimization- direct search methods. Bracketing methods: Exhaustive search method, Region elimination methods: Interval halving method, Fibonacci search method, Golden section search method.

Module 3 (5 hours) Linear Programming: Primal Simplex method, Artificial starting solution, Dual Simplex method, Primal-Dual relationship, Simplex method.

Module 4 (8 hours) Multivariable Optimization Algorithms: Optimality criteria, Unidirectional search, direct search methods, Powell's conjugate direction method. Gradient-based methods: Cauchy's (steepest descent) method, Newton's method. Constrained Optimization Algorithms: Kuhn-Tucker conditions, Transformation methods: Penalty function method, method of multipliers, Direct search for constraint minimization: Variable elimination method

Module 5 (5hours). Dynamic programming, Introduction to Specialized & Non-traditional Algorithms: Genetic Algorithm

Text Books

1 T.F. Edgar and D.M. Himmelblau, "Optimization of Chemical Processes", Mc Graw Hill, International editions, chemical engineering series, 2001

Rao, Engineering Optimization Theory and Practice, Fifth Edition, John Wiley & Sons, Inc., 2019

Beveridge and R.S. Schechter, "Optimization theory and practice", Mc Graw Hill, Newyork, 1970.

Reference book:

1. Hamdy A. Taha, " Operation Research", Pearson, 2008

Web Links

https://archive.nptel.ac.in/courses/103/105/103105139/

Open Elective

OOT:302 INTRODUCTION TO OILS AND OIL PROCESSING

L:T:P:C

2:0:0:2

Preamble:

To provide basic knowledge of oils, fats, detergents, soaps and oleo-chemicals to the students of other disciplines. To make them aware of importance of oils & oleo-chemicals in day to day life.

Prerequisite:

Basic concept of chemistry.

Course Outcome:

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

(CO1)	Understand fundamental chemistry of oils, oleo chemicals and allied products.	Understand
(CO2)	Understand industrial importance of chemicals derived from oils and fats.	Understand
(CO3)	Understand expression and extraction techniques of oil from oil bearing materials.	Understand
(CO4)	Understand the process of refining of crude oils and its importance from health point of view.	Understand
(CO5)	Understand the role and importance of various ingredients in manufacturing soaps and detergents.	Understand

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	2	1	2	1	1	1	3	1
CO2	2	2	1	2	1	2	2	1	1	2	3	2
CO3	1	1	2	1	1	2	1	2	2	1	2	2
CO4	2	2	2	1	2	2	1	2	1	2	3	3
CO5	1	1	1	2	1	1	2	2	1	1	3	2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	20
Understand	30	30	30	30
Apply	20	20	20	20
Analyze	20	20	20	30
Evaluate	20	20	20	0
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Basics of oil seeds, oils, processing technology, various reaction and assessment of raw oil quality to be processed.
2. Selection of optimum technology to be adopted.
3. Knowledge of plant and machinery, their design, preventive and break down maintenance as per process requirement.

Course Outcome 2(CO2)

1. Use of different process as per requirement.
2. Optimum dose of various chemicals at proper process conditions to have effective process control.
3. Adoption of latest process equipments as per different steps required for processing.

Course Outcome 3(CO3)

1. Control over working of different associated plants like chillers, boilers, compressors, Filters, pumps and motors etc.
2. Analysis at different stages to ensure the quality specifications to be adhere..
3. Proper procedures for analysis equipment operation like. G.L.C, U.V Spectro-Photometer to meet out the various specifications as per process being adopted.

Course Outcome 4(CO4)

1. Proper control over process to maintain process log sheets, their study and evaluation.
2. Reduction of wastage at different stages by strict control over process parameters.
3. Control over utility and other inputs to control cost of production.

Course Outcome 5(CO5)

1. Compare the final product as per standard specifications strictly.
2. Cost analysis to assess the position and to arrive at the correct sailing price decision **making**
3. Control is required in all the domains for better productivity and efficiency

Syllabus:

Module-I

Introduction to oils &fats

Introduction to oils & fats, physical and chemical properties of oil , Classification of Fatty acids types of glycerides, theories of glyceride structure, determination of glyceride structure, non-glyceride components of oils, component fatty acids of oils & fats.

Module-II

Chemical reactions of oils & fats

Chemical reactions of oils & fats and their industrial importance, Physical-chemical characteristics of oils & fats, classification of oils, Blending and adulteration of oils.

Module-III

Post harvest technology of oilseeds

Post harvest technology of oilseeds, handling and storage of oilseeds, Oil mill and Pretreatment of oil seeds methods for extraction of oils from oil-bearing materials.

Module-IV

Refining of Oils

Introduction to Refining, Types of Refining, Degumming, Neutralization, bleaching, Dewaxing, Deodorization, Fractionation & Hydrogenation, Winterization of oils, Nutraceuticals'derived fromoils.

Module-V

Biotechnology and other separation processes of crude vegetable oils andspecification of refined oils

Biotechnology: Principle and its application in oil and fat processing, blending of oils, effect of processing on micronutrients, Specifications of oils as per FSSAI.

Reference Books

1. Richard D. O'Brien "Fats and Oils: Formulating and Processing for Applications" 3rd Edition (2008) CRC Press
1. Moghis Ahmad "Fatty Acids: Chemistry, Synthesis, and Applications" 1st Edition AcademicPress and AOCS Press.
2. Robert Selby Morrell, H. R. Wood "The Chemistry of Drying Oils" E. Benn limited.
3. Ian P. Freeman, Sergey M. Melnikov (2015) "Margarines" https://doi.org/10.1002/14356007.a16_145.pub2
4. International Castor Oil Association (1992) "The Chemistry of Castor Oil and ItsDerivatives and their Applications"
5. NIIR Board. The Complete Technology Book on Soaps (2nd Revised Edition)
6. Parasuram K. S. (2002) Soaps and Detergents. Tata Macgraw Hill. (ISBN 007-462324-9)
7. Spitz, L. (2016). Soap Manufacturing Technology: Second Edition.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Introduction to oils & fats**	
1.1	In production to oils and fats types of glycerides	2
1.2	Theory of glycerides structure and determination	1
1.3	Non-glyceride components of oils	1
1.4	Components fatty acids of oils and fat	1
2.	**Chemical reactions of oils & fats**	
2.1	Chemical reactions of oils and fat-industrial importance	1
2.2	Physico-chemicals characteristics of oils and fat	1
2.3	Classification of oils	1

2.4	Adulterations of oils	1
3.	**Post harvest technology of oilseeds**	
3.1	Harvest technology of oil seeds	1
3.2	Handling and storage of oil seeds	1
3.3	Different methods of extraction from oil bearing materials	1
3.4	Expeller, expander	1
3.5	Solvent extraction principle, selection of solvent	1
3.6	Different methods of solvent extraction	1
4.	**Refining of oils**	
4.1	Degumming	2
4.2	Neutralization	1
4.3	Bleaching	1
4.4	Hydrogenation	1
4.5	De-waxing & deodorization	2
4.6	Fractionation	1
4.7	Winterization	1
5.	**Introduction to surface active agents**	
5.1	Saponification of oils, methods of soap manufacture	2
5.2	Selection of raw material	1
5.3	Soap analysis	1
5.4	Surfactants/fat based surfactants	2
	Total hours	**30**

Year -IV, Semester- VII
Programme Elective 2
NOT:401 COMMERCE, PROCESS ECONOMICS, AND SAFETY MANAGEMENT IN OIL INDUSTRIES

L:T: P:C
3:1: 0:4

Preamble:

The course provides necessary knowledge of GST(Goods and Service Tax) and import/export duties on oil seeds and oils, procurement of oil seeds and oil at different level(national/international), preparation of techno-economic feasibility report required for entrepreneurship, treatment of effluents, safety and environmental, eco-friendly and green technology aspect of oil processing industry.

Prerequisite:

Knowledge of engineering operations, commerce & process economics of oil processing industry.

Course Outcome:

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

.(CO1)	Understand Taxes and import-export duties, procurement of oil seeds/oil at different level. Able to start-up MSME along with latest technology and eco-friendly Environmental aspects	Understand
(CO2)	Prepare TEFR(Techno-Economy Feasibility Report) of industries other than oil processing industries.	Apply
(CO3)	Prepare production planning & plant layout of processing plant.	Apply
(CO4)	Assess utilization of by-products of oil seed & oil industry by value addition.	Apply
(CO5)	Assess and apply appropriate effluent treatment process and latest eco-friendly processes and green technology.	Apply

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	1	2	1	3	1	2	2
CO2	3	2	3	3	2	2	2	3	3	2	2	1
CO3	3	3	2	1	2	2	3	2	2	1	2	1
CO4	3	3	2	3	3	2	1	3	3	2	3	3
CO5	3	3	3	2	3	3	2	2	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	20
Understand	10	20	20	20
Apply	40	30	20	20

Analyze	20	20	30	30
Evaluate	20	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Different mechanism involved in procurements of oil seeds and oil.
2. Knowledge of Taxes and import-export duties on oil seeds and oil.
3. Practices of sale of bulk/packaged oils with supply chain management.

Course Outcome 2(CO2)

1. Estimation of capital cost/cost of project of oil processing unit.
2. Technical appraisal of plants.
3. Human resource planning.

Course Outcome 3(CO3)

1. Financial projection of TEFR.
2. Financial analysis such as BEP (Break Even Point), ROR(Rate of Return), PBP(Pay Back Period).
3. Plant layout.

Course Outcome 4(CO4)

1. Processing of by-product such as phospholipids, lecithin/gums.
2. Manufacturing of cattle/poultry field and protein concentrate.
3. Trans-esterification for production of biodiesel.

Course Outcome 5(CO5)

1. Segregation of deodorizer distillate and isolation of value added products.
2. Classification of effluents and its treatments.
3. Fire protection and safety HAZOP guidelines and eco-friendly environmental.

Syllabus:

Module- I

Procurement process for oilseeds and oils taxes & duties:

GST (SGST/IGST) and import/export duty structure for oilseeds, oils (crude and refined), edible as well as non edible. Procurement chain management for oil seeds, oils at national and international level including components of transport, loading/unloading, insurance and storage involved in cycle of procurement. Present day practices of sale through bulk/ packaged imports, with supply chain management.

Module II

Components of Costing, project appraisal and Human resource development:

Capital cost of project for establishing oil mills, solvent extraction plant, oil refinery plant, & other plant related to oil industries, technical appraisal, commercial appraisal & marketing, financial appraisal, management appraisal & economic appraisal-social cost benefits. Human resource Planning: Importance and processes, Job analysis and Engagements, Training need analysis, Management Information System (MIS).

Module- III

Utilities & Production planning:

Financial projections (cost of production and profitability) for oil mills, solvent extraction plant, oil refinery plant & other plant related to oil industries Break Even Point, Rate of Return, Pay Back Period, Depreciation etc. Energy conservation and energy audit in oil processing industry and effective safety management in solvent extraction of edible oils, concept of variable frequency drive, PLC & SAP. Factory lay out: Principles, general considerations, typical flow diagrams, single & multi storied buildings, different sections of a oil refinery factory and their locations, Instrumentation and automation in oil refinery. Machine layout of solvent extraction and oilrefinery plant.

Module-IV

By- products of oil and oilseed processing industry and their utilization:

Phospholipids, production of industrial and edible grade Lecithin, gums. Manufacture of cattle and poultry feed; production of protein concentrates and isolates. Re-esterification of fatty acid with glycerin and its trans-esterification for production of biodiesel. Utilization of deteriorated deep fried oil for industrial utilization. Process audit (Solid waste & by-products, Waste Water, air pollution & hazardous materials etc.)

Module- V

Safety management:

Segregation of deodorizer distillate and isolation of value added products by conventional and molecular distillation and other plants and machinery involved. Classification of effluents of oil and allied industries, Safety considerations in storage of hazardous and inflammable raw materials. Fire Protection and safety: Sources, types, Fire & explosion index, safety measures for protection. Health and Hazards: Resources, competence & regulations, systems & tools, HAZOP guidelines.

Text Books

1.Handbook on Project Appraisal & follow-up by D. P. Sarda

2.Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)

Reference Books:

1.Plant Design & Economics by Peter Timmer House

2.Air & Water by Giringer

3. Efficient use of Steam by Goodall

Web Links:

1.https://www.youtube.com/watch?v=3eotPsfp9q4

2.https://www.policybazaar.com/tax/#:~:text=In%20a%20broader%20term%2C%20there,%2C%20value%20added%20tax%2C%20etc.

3.https://cleartax.in/s/gst-law-goods-and-services-tax

4.https://dfpd.gov.in/export-import-policy-edible-oil.htm

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Procurement process for oilseeds and oils**	
1.1	Different mechanism involved in procurement of oil-seeds and oil atnational-international level	1
1.2	Taxes and import-export duty structure on oil-seeds and oil	1
1.3	Component of transport labor insurance and storage involve in cycle orprocurement	1
1.4	Present day practices of sale through bulk/packaged	1
1.5	Supply chain management for sale of oils	1
2.	**Components of Costing and Human resource development**	
2.1	Working out the capital cost of project for establishing oil mills and solventextraction plant	2
2.2	Working out the capital cost of project for establishing of oil refinery andother plant related to oil industries	2
2.3	Technical appraisal of plants	2
2.4	Human resource planning	1
2.5	Job analysis, engagements and training analysis	1
3.	**Utilities & Production planning**	
3.1	Financial projection i.e. calculation of cost of production for oil mill andsolvent extraction plant	2
3.2	Financial projection i.e. calculation of cost of production for oil refinery andother plant related to oil refinery plant and other plants related to oil industries	2
3.3	Energy conservation in oil processing industry	1
3.4	Financial analysis i.e. break-even point and rate of return	1
3.5	Financial analysis i.e. pay-back period and depreciation	1
3.6	Factory layout of solvent extraction and oil refinery	1
3.7	Machine layout in solvent extraction and oil refinery	1
3.8	Instrumentation and automation in oil refinery	1
4.	**By- products of oil and oilseed processing industry and their utilization**	
4.1	Phospholipids, production of industrial and edible grade Lecithin gums	2
4.2	Manufacture of cattle and poultry feed	1
4.3	Production protein concentrates and isolates	1
4.4	Re-esterification of fatty acid with glycerin	1
4.5	Trans-esterification for production of bio-diesel	2
4.6	Utilization of deteriorated deep fried oil for industrial utilization	1
5.	**Safety measures, Effluents and their treatment**	
5.1	Segregation of deodorizer distillate and isolation of value added product byconventional and molecular distillation	2
5.2	Classification of effluents of oil and allied industry	2
5.3	Safety consideration in storage of hazardous and inflammable raw materials	1
5.4	Fire protection and safety	1
5.5	Health and hazard regulations	1
5.6	HAZOP guidelines	1
5.7	Environment eco-friendly, waste minimization and waste disposal	1
5.8	Effluent treatment plants, system efficiency etc.	1
5.9	GOI specification of effluents, eco-friendly processes and green technology	2
	Total	**43**

NOT:403 BIOTECHNOLOGY OF OILS AND OILSEED

L : T: P:C
3 : 1: 0:4

Preamble:

This course has been designed to utilize knowledge of bio-technology for oil bearing materials and oils. Scenario of GM crops along with application of bio- technology for edible oils, foods and lipid sciences for better value addition**.**

Prerequisite:

Basic science and engineering and oil technology

Course Outcome:

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

(CO1)	Understand GM crops, oil bearing GM crops, their composition and Characteristics, Non-GM crops, word trend and scenario of GM crops.	Understand
(CO2)	Apply bio-technology specially to lipid sciences & prepration of different enzymes for oil & allied industries processing of bio-degumming by use of enzyme, bio-deacidification, bio-inter-esterification	Apply
(CO3)	Apply knowledge of bio-technology for inter- esterification for production ofstructured lipids, margarine And shortening, cocoa-butter substitutes, esters etc. More over oleo-chemicals, bio-surfactants And other medicine products.Production of bio-diesel by cheaper materials, application of bio chemicals process in Water effluent treatment plant, preparation of polyol and otheresters.	Apply
(CO4)	Understand and analyze modification processes of oil seed such as canola oilproduction, low Erucic mustard oil, low linoleic soybean oil, high oleic sun flower oil and low linolenic Canola oil processing of these oils by using the bioprocess & chemical process & their cost effectiveness.	Analyze
(CO5)	Evaluation of the products produced by bio-chemical process with conventional Process to evaluate the merits and de-merits of the same.	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	3	1	2	2	2	2	3	2
CO2	2	3	2	2	3	2	3	2	3	3	3	2
CO3	2	3	2	3	3	3	2	3	2	3	3	2
CO4	2	2	2	2	3	3	2	2	2	2	3	2
CO5	3	3	2	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	30	20	20
Apply	20	20	30	20
Analyze	30	20	20	30
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. GM crops to be evaluated with Non-GM crops for yield and other parameters to know the further expansion of the product
2. Evaluation and comparison of characteristics.
3. Knowledge of processing and plant required for production of the same.

Course Outcome 2(CO2)

1. Bio-processing technology for effective and efficient process like enzymatic degumming to be adapted to control cost of production and better yield in terms of quality and quantity.
2. Other process like bio-deacidification, inter-estrification to be done with proper dose of enzyme.
3. To increase the use of bio-technology for other value added products for food and medicinalpurpose.

Course Outcome 3(CO3)

1. Production of bio-diesel by cheaper materials,
2. Application of bio chemicals process in water effluent treatment plant.
3. Preparation of polyol and other esters.

Course Outcome 4(CO4)

1. Control over manufacture of products like low linolenic canola, low erucic mustard oil, high. oleic sun flower oil to explore markets for these specialty products
2. Inter-estrified fats and other products like cocoa-butter substitutes quality and availability at lower cost.
3. Proper knowledge of plant and machine required at cost effective parameters.

Course Outcome 5(CO5)

1. Product manufactured by bio-technology process must confirm to specification fixed and effective control over different parameters is required.
2. Bio-diesel is very good alternative to our naturally obtained petroleum products. Only sustainableand cost effective processing is required.
3. Special products manufactured by bio-technology route are being popular and have good marketingscope.

Syllabus:

Module-I
Introduction to GM crops
Genetically modified crops for oil bearing materials: Physical, chemical and nutritional functionality modifications, certification of GM crops, global as well as Indian scenario in GM crops.

Module-II
Enzymes and their Technology
Types of enzymes, sources and their isolation and their applications, immobilized enzymes, , factors affecting enzyme activity, enzyme kinetics

Module –III
Bio processing of Oils & Fats

Bio Processing of Oils: Bio degumming, Bio de-acidification, Bio bleaching, Chemistry and technology of bio-interesterification, Principles in bioremediation and biological water & waste treatment

Module –IV

Specialty fats & Oils

Structured Lipids, Margarine and Shortening, Production of plastic fats, Cocoa butter substitute, Food emulsions, Medicinal applications, Preparation of de-acylglycerols, polyol and other oleo chemicals.

Module –V

GM Oilseeds

Canola (rapeseed), Linola (flax), High Oleic sunflower, Low-linolenic soyabean etc.

Reference Book

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman &Company, 2004.
2. Lubert Stryer, Biochemistry, 4th Edition, W.H.Freeman and Company, 1995
3. Biotechnology for the Oils & fats industry (1983) Edited by Colin Ratledge, Peter Dawson and James Rattray
4. Bailey J.E and Ollis D.F., "Biochemical Engineering Fundamentals", 2nd 1987 Ed., McGraw Hill.
5. Doble M. and Gummadi S.N., "Biochemical Engineering", Prentice Hall 2007.
6. Schuler M. L. and Kargi F., "Bio Process Engineering", 2nd Ed., 2002 Prentice Hall.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Introduction to GM crops**	
1.1	Genetically modified crops for oil bearing materials	2
1.2	Composition, characteristics, composition of GMand non-GM crops	2
1.3	Certification of GM crops	2
1.4	Global scenario in GM crops	2
2.	**Enzymes and their Technology**	
2.1	Types of enzymes, sources and their isolation	2
2.2	Application of enzymes	2
2.3	Immobilized enzymes	1
2.4	Assay of enzymes for oil application	1
2.5	Enzymatic degumming, process, advantage over conventional degumming	2
3.	**Bio processing of Oils & Fats**	
3.1	Bio Processing of Oils: Bio degumming	2
3.2	Bio de-acidification	1
3.3	Bio bleaching, Chemistry	2
3.4	Bio-interesterification	1

3.5	Interesterified fats vis-a-vis bio-interesterified fats/hydrogenated fats.	2
4.	**Speciality fats & Oils**	
4.1	Structured Lipids	1
4.2	Margarine and Shortening	1
4.3	Production of plastic fats	2
4.4	Cocoa butter substitute	1
4.5	Food emulsions	1
4.6	Medicinal applications	1
4.7	Preparation of de-acylglycerols, polyol and oleo-chemicals	1
5.	**GM Oilseeds**	
5.1	Canola (rapeseed)	2
5.2	Linola (flax)	1
5.3	High Oleic sunflower	1
5.4	Low- linolenic soybean	1
5.5	Low linoleic canola	1
	Total	**38**

NOT: 405 LIPID BIOTECHNOLOGY

L:T:P:C
3:1:0:4

Preamble

This course is designed to gain the insights about various bio-simulated reactions, pathways, and mechanisms in natural way. Also, the use of enzymes for synthetic modification and applications several fatty products will be studied. Environmental issues from biotechnological industries will also be discussed.

Prerequisite:

Advance science and engineering and oil technology

Course Outcome:

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

(CO1)	Acquire the fundamental knowledge of scholarly discourse in lipid synthesis, recognize the biological roles vitamins and examine the toxicology of lipidcomponents.	Understand
(CO2)	Combine the theories and concepts of microbial lipase in industrial applications.	Understand
(CO3)	Illustrate the critical skills in solving the reaction kinetics and optimizing theenzymatic process.	Apply
(CO4)	Differentiate between structured and genetically modified lipids, and identify ethical issues in environmental bioremediation.	Analyze
(CO5)	Evaluate synthesis and inter conversion of fatty acid and determination of glycerides structure of fats by enzymatic methods	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	3	1	2	2	2	2	3	2
CO2	2	3	2	2	3	2	3	2	3	3	3	2
CO3	2	3	2	3	3	3	2	3	2	3	3	2
CO4	2	2	2	2	3	3	2	2	2	2	3	2
CO5	3	3	2	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	30	20	20
Apply	20	20	30	20
Analyze	30	20	20	30
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Animal lipid sources
2. Lipids in human nutrition
3. The lipid soluble vitamins

Course Outcome 2(CO2)

1. Single cell lipids their production and applications
2. Genetically modified oils their properties
3. Genetically modified oil's applications & ethical values

Course Outcome 3(CO3)

1. Isolation of stains from different sources
2. Production of enzymes Mechanism of enzyme action, determination of enzyme assay
3. Immobilization of enzymes, Reaction kinetics & application of enzymes

Course Outcome 4(CO4)

1. Structure, isolation of proteins
2. Isoelectric PH and function
3. Gene protein relationship & protein metabolism

Course Outcome 5(CO5)

1. Synthesis of triglycerides & Regulation of lipid metabolism
2. Phosphoglycerides, Sphingolipids and sterol metabolism
3. Determination of glyceride structure of fats by enzymatic methods

Syllabus:

MODULE-1

Biosynthesis of fatty acids and phospholipids; Mechanism of chain elongation and desaturation of acyl chains; Regulation of lipid metabolism; Biological role of fat in human nutrition; Atherosclerosis.

MODULE-2

EFA, MUFA, PUFA –Sources and biological activities in human health; Biochemical aspects of vitamins in nutrition; Toxic constituents in oilseeds and oils: Sources, structures, toxicological effects and methods of detoxification.

MODULE-3

Microbial production of fats and other lipids; Biotransformation of fats and lipids using whole microbial cells; General aspects of Microbial Lipases: Sources, isolation and purification and industrial applications

MODULE-4

Enzymatic Interesterification: Chemistry, reaction in (aqueous/organic) solvent systems, immobilization of enzymes, Biohydrogenation, Biodeacidification

MODULE-5

Structured lipids: Synthesis, analysis and applications. Plastic Fats & Cocoa Butter Equivalent

Reference Books:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman & Company, 2004.
2. Lubert Stryer, Biochemistry, 4th Edition, W.H.Freeman and Company, 1995
3. Outline of Biochemistry by Eric.E. Conn and P.K. Stumpf, 5thedition, Wiley India.
4. Lipids: Biochemistry, Biotechnology and Health, 6th Edition by Michael I. Gurr, John L.Harwood, Keith N. Frayn, Denis J. Murphy, Robert H. Michell, WileyBlackwell
5. Fatty Acids in Fish Oğuz Taşbozan and Mahmut Ali Gökçe http://dx.doi.org/10.5772/68048
6. Food Lipids Chemistry, Nutrition, and Biotechnology, Fourth Edition Edited Casimir C. Akoh Taylor & Francis Group

Course contents and Lecture schedule:

ModuleNo.	Topic	No. of Lectures
1.	**Plant lipid sources**	
1.1	Animal lipid sources	2
1.2	Lipids in human nutrition	3
1.3	The lipid soluble vitamins	3
2.	**Biochemical Organization**	
2.1	Single cell lipids their production and applications	3
2.2	Genetically modified oils their properties	3
2.3	Genetically modified oil's applications & ethical values	3
3.	**Enzymes their classification**	
3.1	Isolation of stains from different sources	2
3.2	Production of enzymes Mechanism of enzyme action, determination of enzyme assay	3
3.3	Immobilization of enzymes, Reaction kinetics & application of enzymes	3
4.	**Protein synthesis**	

4.1	Structure, isolation of proteins	2
4.2	Isoelectric PH and function	2
4.3	Gene protein relationship & protein metabolism	2
5.	**Synthesis and inter-conversion of fatty acids**	
5.1	Synthesis of triglycerides & Regulation of lipid metabolism	3
5.2	Phosphoglycerides, Sphingolipids and sterol metabolism	3
5.3	Determination of glyceride structure of fats by enzymatic methods	3
	Total	**40**

Programme Elective III

NOT:407 Quality Assurance of Oils and Allied Products

L:T:P:C

3: 0: 0:3

Preamble:

The subject deals with the study of techniques used for controlling and assuring the quality parameters of oil, fats and allied products. The detailed discussion of various techniques of chromatography and spectroscopy helps the students to work efficiently in the R&D and QC sections of the industries. The subject also expose the students to the safety measures and good manufacturing practices.

Prerequisite:

Fundamental knowledge of fatty acid composition of oils and chromatographic & spectroscopic techniques.

(CO1)	Understand the quality parameters of oils and allied products.	Understand
(CO2)	Use the acquired knowledge for controlling and assuring the quality parameters of oils and allied products.	Apply
(CO3)	Use the chromatographic & spectroscopic techniques for analysis of oils, oleo chemicals and allied products	Analyze
(CO4)	Use the knowledge for developing and confirming the composition of developed products.	Create
(CO5)	Use modern techniques for ensuring good manufacturing practices.	Apply

Course Outcome:

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

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	3	2	3	2	2	3	1	3	1
CO2	3	3	3	3	3	3	2	3	3	2	3	2
CO3	3	3	2	1	3	2	3	3	2	1	3	2
CO4	3	3	3	2	3	3	2	2	3	3	3	2
CO5	3	3	2	3	3	2	3	3	3	2	3	2

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	30	30	20
Apply	10	20	20	20
Analyze	40	10	20	30
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Quality control and quality assurance in oils and allied industries.
2. Good manufacturing practices in the industry.
3. Hazard analysis and critical control points in oils and allied industries.

Course Outcome 2(CO2)

1. Role of chromatographic techniques in quality control of oils and fats.
2. Principle and application of GLC, HPLC & SFC.

Course Outcome 3(CO3)

1. Role of spectroscopic techniques in quality control of oils and fats.
2. Principle and application of UV-VIS, FTIR & NMR.\

Course Outcome 4(CO4)

1. Estimation of metallic impurities in oils.
2. Estimation of vitamin A, D & E(natural & fortified).

Course Outcome 5(CO5)

1. Principle and application of hyphenated technique like TLC-FID/FPD, LCMS etc..Working of mass spectrophotometer.

Syllabus

Module –I

Quality control and Quality Assurance

Concept of quality assurance and quality control in relation to oil industry; quality manage- ment systems - ISO 9000; total quality management (TQM); hazard analysis of critical control points (HACCP); Good Lab Practices (GLP), good manufacturing practices (GMP); role of international organisations such as ISO; IDF; CAC; AOAC; AOCS; WTO and national organisations like BIS; and Agmark; FSSAI and APEDA (Agricultural and Processed Foods Export Development Authority) in oil industry; guidelines for setting up quality control laboratory. Legislation on oils and allied products

Module–II

Chromatographic Techniques

Theoretical developments of various techniques viz. thin layer chromatography, column chromatography, gas-liquid chromatography, HPLC and Super critical Chromatography; their principles, practices and their applications in the quality control and quality assurance of oils, fats and allied products.

Module –III

Spectroscopic Techniques

Ultra-Violet, Visible, FTIR, NIR and NMR, Mass spectroscopic techniques: principles, practices and their application in the analysis of oils and allied products; Interpretation ofspectra and quantitative applications.

Module –IV

Special quality control methods

Nickel content of catalyst and hydrogenated oils; iron, sulphur and phosphatide content of crude and refined vegetable oils; wax content of vegetable oils; Vitamin A, D & E(natural & fortified); residual

pesticide and solvent analysis, chlorophyll content, amino acid analysis bychemical and instrumental method etc.

Module –V

Hyphenated techniques

TLC-FID/FPD, GC-MS, SFC-GC, LC-MS, ICP-MS, AAS in analysis of oils and fats.

Reference Books and suggested readings:

1. Manual of Methods of Analysis of Foods, Oils and Fats. Food Safety and Standards Authority of India, 2015
2. Laboratory Handbook for Oil and Fat Analysts. L. V. Cocks and C. Van Rede
3. Standard Methods for the Analysis of Oils, Fats and Derivatives. C. Paquot, Pergammon Press, 6th Edition, 2013
4. Chemistry and Technology of Oils and Fats. M.M Chakrabarty, Allied PublishersPvt. Ltd. New Delhi
5. Fats and Oils Formulating and Processing for Applications, 3rd Edition Richard
6. D.O. Brien, 2009Principles of Instrumentation analysis, Edition- III (1985) Edited byDouglas A. Skog
7. Standard methods of analysis CODEX, BIS, AOCS, ISO, FSSAI.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Quality control and Quality Assurance**	
1.1	Concept of quality assurance and quality control in relation to oil industry	2
1.2	Quality management systems - ISO 9000; total quality management (TQM);hazard analysis of critical control points (HACCP); good manufacturing practices (GMP)	2
1.3	Role of international organizations such as ISO; IDF; CAC; AOAC; WTOand national organizations like BIS; and Agmark; FSSAI and APEDA (Agricultural and Processed Foods Export Development Authority) in oil industry	2
1.4	Guidelines for setting up quality control laboratory. Legislation on oils and allied products	2
2.	**Chromatographic Techniques**	
2.1	Theoretical developments of various chromatographic techniques	2
2.2	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of thin layer chromatography	1
2.3	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of column chromatography	1
2.4	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of gas-liquid chromatography	1
2.5	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of HPLC	1
2.6	Principles, practices and applications in the quality control and quality assurance of oils, fats and allied products of Super critical Chromatography	1
3.	**Spectroscopic Techniques**	

3.1.	Principles, practices and applications in the quality control and quality of Ultra-Violet Visible	1
3.2.	assurance of oils, fats and allied products of FTIR	1
3.3.	Principles, practices and applications in the quality control and quality of NIR and NMR	2
3.4.	assurance of oils, fats and allied products of	1
3.5.	Mass spectroscopic techniques: principles, practices and their application in the analysis of oils and allied products	1
4.	**Special quality control methods**	
4.1.	Determination of iron, sulphur and phosphatide content of crude and refined vegetable oils	1
4.2.	Determination of wax content of vegetable oils	1
4.3.	Determination of Vitamin A, D & E(natural & fortified)	1
4.4.	Determination of chlorophyll content, amino acid analysis bychemical and instrumental method etc	2
4.5.	Residual pesticide and solvent analysis	1
5.	**Hyphenated techniques**	
5.1.	Principles, practices and applications in the quality control and quality TLC-FID/FPD	1
5.2.	assurance of oils, fats and allied products of GC-MS	2
5.3.	Principles, practices and applications in the quality control and quality SFC-GC	1
5.4.	assurance of oils, fats and allied products of LC-MS	2
5.5.	Principles, practices and applications in the quality control and quality ICP-MS and AAS	1
	Total hours	**38**

NOT: 409 PACKAGING OF OILS, FATS AND ALLIED PRODUCTS

L:T:P:C
3:0:0:3

Preamble:

This course has been designed to provide knowledge for packaging of oils, fats, soaps detergent, cosmetics and allied products. Awareness of packed edible oils/other products reduces thechances of adulteration.

Prerequisite:

Basic knowledge of engineering & technology, material science, oil and oil based products**.**

Course Outcome:

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

(CO1)	Understand the elements of packaging and different types of packaging materials.	Understand
(CO2)	Select packaging materials to pack the products considering the environmental aspects and cost.	Apply
(CO3)	Select materials and methods for printing on packaging materials surfaces.	Apply
(CO4)	Analyze the influence of packaging on the consumers.	Analyze
(CO5)	Assess environmental aspects of plastic material for packaging and future road map to eco-friendly packaging materials.	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	2	2	1	2	2	3	2
CO2	3	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	2	3	2	3	3	3	2	3	3	3
CO4	2	2	3	2	2	3	3	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	20	20	20
Apply	20	20	20	20
Analyze	30	30	30	30
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Elements of packaging and its influence on customers.
2. Scope and function of a package.
3. Comparison of glass and plastic packaging.

Course Outcome 2(CO2)

1. Compatibility with the material to be packed.
2. Properties of various packaging materials, essential components &criteria forselection of packaging materials
3. Edible packaging and eco-friendly alternative to the plastic

Course Outcome 3(CO3)

1. Different forms of packing rigid, semi-rigid and flexible.
2. Types of polymers use as packaging materials.
3. Useful commercial blend of polymers for packaging.

Course Outcome 4(CO4)

1. Co-extrusion, extrusion Coatings and laminations process technology of the packaging.
2. Typical laminates film's constructions and its benefits & application.
3. Coating weight "Neck-in" and drawdown in extrusion Coatings and laminations.

Course Outcome 5(CO5)

1. Packaging materials use for soap, detergent & cosmetics
2. Limitation of solid waste management practices
3. Physical & chemical tests of packing materials

Syllabus:

Module I

Introduction to Packaging

Elements of packaging & its influence on customers, scopes and functions of a package. Materials used for packaging:paper and paperboards; films and foils; glassware; metals plastics; wood; miscellaneous other materials. Comparison of glass & plastic packaging.

Module II

Criteria and selection of packing material

Requirements of packaging surfaces for oils and allied products viz. Compatibility with thematerial to be packed, properties of various packaging materials and their specifications,& essential components for selection of packaging materials, essential criteria for selection of packaging materials,Different

packaging and sealing machine for liquid /semisolid packaging. Edible packaging &eco friendly alternative to the plastic

Module III

Forms of packaging:

Folded cartons/boxes; corrugated board boxes, metal containers bags and envelopes, aerosols.Tubes, cans and different forms of plastics, types of polymers use as packaging materials & useful commercial blend of polymers packaging.

Module IV

Printing of packaging surfaces

Requirements of Printing and evaluation of printed surfaces, co-extrusion, extrusion Coatings and laminations of thepackaging surfaces, types and properties of coatings and limitations, different types of laminating machines. Typical laminates film's constructions and its benefits & application. Coating weight "Neck-in" and drawdown in extrusion Coatings and laminations, lamination machines.

Module V

Packaging of various products

Oils and fats, soaps and detergents; cosmetics; petrochemicals, wax and wax products; essential oils and perfumes; lubricating oils and greases; by products of oils, soaps and allied industries. Food packaging & its environmental impacts. Limitation of solid waste management practices. Types of packaging material and environmental issues, advantages and disadvantages.Minimizing environmental impact. Physical & chemical tests of packing materials.

Reference Books and suggested readings

1. Handbook of food packaging by F. A Paine and H.Y paine., Publisher: Blackis and Son Ltd London (1983)
2. Food Packaging Principles and Practice: Gordon L. Robertson
3. Modern processing and distribution system for food edited by F. A Paine
4. Food and packaging interaction by Risch. S. H., Publisher: American chemical Society, Washington (1991)
5. Packaging materials and containers by Paine F. A., Publisher: Blackis and sons Ltd,London (1983)
6. Mathlouthi, M. Food Packaging and Preservation. Gaithersburg: Aspen, 1999
7. Paine F. A . Packaging media Publisher: Blackis and son Ltd; Bishop Briggs (1977)
8. Bureau, G., and J. L. Multon. Food Packaging Technology. New York, n.d. (1996)
9. Chemistry of Food Packaging by Swalam C.M., American Chemical Society, WashingtonD. C. 1974.
10. Packaging. Rockport, MA: Rockport Publishers, 1995.

Module No.	Topic	No. of Lectures
1.	**Introduction to Packaging**	
1.1	Elements of packaging and its influence on customers	2
1.2	Scope and function of a package	1
1.3	Materials used for packaging i.e. paper and paperboards, Films and Foils	1
1.4	Materials used for packaging i.e. glassware, metals, plastics, wood and miscellaneous other materials	2
1.5	Comparison of glass & plastic packaging	1
2.	**Criteria and selection of packing material**	
2.1	Compatibility with the material to be packed	1
2.2	Properties of various packaging materials and their specifications	2
2.3	Essential components for selection of packaging materials	1
2.4	Different packaging and sealing machine for liquid/semi-liquid packaging	2
2.5	Edible packaging &eco friendly alternative to the plastic	1
3.	**Forms of packaging**	
3.1	Different forms of packaging i.e. folded cotton/boxes corrugated boxes	1
3.2	Different forms of packaging i.e. metal containers, bags and envelops, aerosols.	1
3.3	Different forms of packaging i.e. Tubes cans	1
3.4	Different forms of packaging i.e. rigid, semi-rigid and flexible plastic packaging	2
3.5	Polymers used for packaging materials	1
4.	**Printing of packaging surfaces**	
4.1	Requirement of printing and evaluation of printed surfaces	1
4.2	Co-extrusion, extrusion coating and extrusion laminations of the packaging	2
4.3	Different types of lamination machine	2
4.4	Typical laminates film's constructions and its benefits & application	2
4.5	Coating weight "Neck-in" and drawdown in extrusion Coatings and laminations.	1
5.	**Packaging of various products**	
5.1	Packaging of soap and detergents	1
5.2	Packaging of cosmetics	1
5.3	Packaging of petro-chemical, wax and wax-products	1
5.4	Packaging of essential oils and perfumes	1
5.5	Packaging of lubricating oils and grease	1
5.6	Packaging of bye-product and allied industries	1
5.7	Limitation of solid waste management practices.	1
5.8	Types of packaging material and environmental issues, advantages and disadvantages.	1
5.9	Minimizing environmental impact.	1
5.10	Physical & chemical tests of packing materials.	1
	Total	**38**

NOT: 411 BY-PRODUCTS UTILIZATION AND WASTE MANAGEMENT

L : T: P:C
3 : 0: 0:3

Preamble:

By-products Utilization and Waste Management from industrial operation is important phenomenon which needs specific attention by industries. This course has been designed to make students aware environmental aspects in industrial operation in particular oil & allied industries. The course alsoincludes study on ISO-14000 and all other environmental management system.

Prerequisite:

Knowledge of engineering and oil processing.

Course Outcome

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

CO1	Understand basics of waste management (K2)
CO2	Evaluate possible utilization and value addition to the byproducts (K5)
CO3	Develop or synthesis of novel oleochemicals from waste streams/ byproducts (K3)
CO4	Evaluate and design various techniques for waste water treatments and pollution control (K5)
CO5	Summarise about technologies available for applications of byproducts (K3)

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	3	3	3	0	0	0	1	3	2
CO2	3	3	2	3	2	3	3	3	0	0	0	2	3	3
CO3	3	3	2	2	2	3	3	3	0	0	0	2	3	3
CO4	3	3	2	3	2	3	3	3	0	0	0	2	3	3
CO5	3	3	2	3	2	3	3	3	0	0	0	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contribution K, knowledge level from cognitive domain; A, Affective domain; Psy, Psychomotor domain

Syllabus:

Module I

Disposal and utilization of by-products from oil processing industries: gums, soap-stock,acid oil, spent bleaching earth, deodorizer distillates and fatty acid distillates, spent nickel catalyst, glycerin and fatty acid distillation residues/pitch.

Module 2

Protein based surfactants, microbial surfactants, Utilization of Waste frying oils, glycerin from bio-diesel industry

Module 3

Utilization of oilseed hulls (groundnut, sunflower), husk (rice bran), shell (coconut,cottonseed) and residues, production of surfactants from protein residues

Module 4

Green and Novel Surfactants: Route of synthesis, physiochemical properties and industrial applications of Methyl Ester Ethoxylates, Gemini surfactants, Alkyl polyglycosides, Esterquats etc.

Module 5

Valorization of edible oil byproducts viz Biochar Synthesis, Nanocarbon Synthesis, Bioadhesive Synthesis and Nutraceuticals isolation

Course contents and Lecture schedule:

S. No.	Topic	No. of Lecturers
1.	**UNIT 1**	
1.1.	Disposal and utilization of gums and Waxes	**2**
1.2.	Disposal and utilization of soap-stock and acid oil	**2**
1.3.	Disposal and utilization of spent bleaching earth and deodorizer distillates and fatty acid distillates	**2**
1.4.	Disposal and utilization of spent nickel catalyst	**1**
1.5.	Disposal and utilization of glycerin and fatty acid distillation residues/pitch	**1**
1.	**UNIT 2**	
2.1.	Protein based surfactants	**2**
2.2	Microbial surfactants	**2**
2.3	Utilization of Waste frying oils	**2**
2.4	Glycerin from bio-diesel industry	**1**
3.	**UNIT 3**	
3.1	Utilization of oilseed hulls (groundnut, sunflower)	**2**
3.2	Utilization of husk (rice bran)	**2**
3.3	Utilization of shell (coconut,cottonseed) and residues	**2**
3.4	Utilization of production of surfactants from protein residues	**2**
4.	**UNIT 4**	
4.1	Green and Novel Surfactants: Route of synthesis, physiochemical properties and industrial applications of Methyl Ester Ethoxylates	**2**
4.2	Route of synthesis, physiochemical properties and industrial applications of Gemini surfactants	**2**

4.3	Route of synthesis, physiochemical properties and industrial applications of Alkyl polyglycosides	**2**
4.4	Route of synthesis, physiochemical properties and industrial applications of Esterquats	**1**
5.	**UNIT 5**	
5.1	Valorization of edible oil byproducts viz Biochar Synthesis, Nanocarbon Synthesis, Bioadhesive Synthesis and Nutraceuticals isolation	**8**
	Total	**38**

Reference Books and suggested readings:

1. Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)
2. Treatise on fats, fatty acids and oleochemicals by O. P. Narula Vol. I & II, Industrial Consultants (India), (1994)
3. Natural fatty acids and their sources by E. H. Pryde

Programme Elective IV

NOT:413 PETROLEUM PRODUCTS AND PETROCHEMICALS

L : T: P:C

3 :0: 0:3

Preamble

The course provides basic knowledge of Petroleum, its occurrence in the crust of earth, various theories of formation & its relevance, products& various petrochemicals.

Prerequisite:

Knowledge of basic chemistry of hydrocarbons, synthesis processes, applications of petrochemicals.

Course Outcome:

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

(CO1)	Understand the occurrence of crude petroleum, its exploration, distillation & exposure of products & by-products	Understand
(CO2)	Understand processing of crude petroleum viz desalting, atmospheric & vacuum distillation etc.	Understand
(CO3)	Apply various conversion processes for conversion of small C chain to large & vice-versa to get variety of products.	Apply
(CO4)	Assess quality of crude, selection of method of refining and manipulating the yield of particular fraction.	Analyze
(CO5)	Apply knowledge to synthesize specific polymer products.	Apply

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	2	1	2	1	2	2	3	2
CO2	2	2	2	2	3	2	3	2	3	3	3	2
CO3	2	2	2	2	2	3	2	3	2	3	3	2
CO4	2	2	3	2	2	3	2	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	20	20	20
Apply	20	20	20	20
Analyze	30	30	30	30
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Survey of oil reserves in country and the world.
2. Knowledge of various refineries and their capacities in India and abroad.
3. Knowledge of test methods and evaluation of oil stocks.

Course Outcome 2(CO2)

1. Selection of process for processing of crude petroleum.
2. Distillation processes e.g. Atmospheric & vacuum.
3. Various distillation products e.g. natural gas, gasoline, fuel oils, lubricating oils,waxes, tar & asphalt.

Course Outcome 3(CO3)

1. Conversion processes for converting long carbon chain to small carbon chain products.
2. Conversion processes for converting small carbon chain to long carbon chain products.
3. Study of various feed stocks for the conversion processes.

Course Outcome 4(CO4)

1. Extraction of waxes-paraffin, micro crystalline.
2. Extraction of asphalt from the residues.
3. Process like vis-breaking enabling feed stock for further processes.

Course Outcome 5(CO5)

1. Manufacture of basic raw material for polymerization like ethylene.
2. Manufacture of alkyl aryl compounds, ethylene oxide condensation products.
3. Manufacture of benzene, toluene, xylene & styrene.

Syllabus:

Module I

Introduction to mineral oils:

Origin and mode of occurrence. Oil resources and refineries in India. Composition of petroleum, Refinery products and their test methods. Evaluation of oil stocks

Module II

Processing of petroleum;

Processing of crude oil distillation, refinery products and their applications, natural gas, gasoline, naphtha kerosene, fuel oils and gas oils, petroleum waxes, lubricating oils, tar and asphalt.

Module III

Petroleum refining processes and operations:

Thermal cracking, catalytic cracking, hydro-forming, catalytic reforming, alkylation, polymerization, isomerisation.

Module IV

Auxiliary processes:

Vis-breaking, de-waxing and de-asphalting operations. Manufacture of paraffin wax and microcrystalline waxes.

Module V

Petrochemicals;

Manufacture of alkyl aryl compounds, ethylene oxide condensation products benzene, toluene, xylene, buta-di-enes, vinyl chloride and styrene etc.

Reference Book

1. Nelson W. L., "Petroleum Refinery Engineering" 4th Ed.., McGraw Hill 1987
2. Wauquier J. P., "Petroleum Refining 2 Separation Processes", Vol:1-5, IFP,Technip Ed. 1998
3. Meyers R. A., "Hand book of Petroleum Refining Processes", 3rd Ed., TheMcGraw-Hill Publication Data 2004
4. Dawe R. A., "Modern Petroleum Technology- Part I", by Institute of Petroleum(IP), John Wiley 2002
5. Prakash Surinder " Refining Processes Hand book" Elsevier 2003
6. Hobson,G.D." Modern Petroleum technology Volume I & II" Wiley 1984
7. Bhaskar rao, B.K. "Modern Oetroleum refining processes" Oxford &IBHPublishing Co Pvt.Ltd. 2005

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Introduction to mineral oils**:	
1.1	Introduction & origin of crude	1
1.2	Occurrence in earth crust	1
1.3	Refineries in India	1
1.4	Composition of petroleum	1
1.5	Refinery products	2
1.6	Test Methods	2
1.7	Oil Stock evaluation	1
2.	**Processing of petroleum**;	
2.1	Crude oil distillation	2
2.2	Refinery products and applications	2
2.3	Natural gas	1
2.4	Gasoline	1
2.5	Naphtha	1
2.6	Fuel oils & gas oils	1
2.7	Petroleum waxes	1
2.8	Lubricating oils	1
2.9	Tar & asphalt	1
3.	**Petroleum refining processes and operation**s	
3.1	Thermal cracking	1
3.2	Catalytic cracking	1
3.3	Hydro-forming, Catalytic reforming	1
3.4	Alkylation	1

3.5	Polymerization	1
3.6	Isomerisation	1
4.	**Auxiliary processes**	
4.1	Vis- breaking	1
4.2	De-waxing and manufacture of paraffin & micro crystalline wax	2
4.3	De-asphalting	1
5.	**Petrochemicals**	
5.1	Manufacture of alkyl aryl compounds	1
5.2	Ethylene oxide condensation products	1
5.3	Manufacture of benzene	1
5.4	Manufacture of toluene	1
5.5	Manufacture of xylene	1
5.6	Manufacture of butadiene	1
5.7	Manufacture of vinyl chloride	1
5.8	Manufacture of styrene	1
	Total	**38**

NOT:415 Nutraceuticals and Functional Additives

L : T: P:C
3 : 0: 0:3

Preamble:
This course has been designed to provide knowledge of human nutrition and role of nutrition in growth & health through the life cycle. The course also provide awareness of nutritional importance of oil & fats function in food and various food constitute responsible for functional effects and processing of health & foods.

Prerequisite:
In depth, the knowledge of nutrition, its role and importance in growth & healthof human life cycle.

Course Outcome:
On successful completion of the course, students will be able to

CO1	Able to understand basics of nutraceuticals and regulatory issues (K2)
CO2	Discuss about properties and functions of nutraceuticals (K4)
CO3	Summaries on available technologies for manufacturing of nutraceuticals (K3)
CO4	Evaluate the nutritional genomics and market information (K5)
CO5	Discus on the applications, Consumers' views on nutraceuticals as well as Labeling andclaims for Nutraceuticals products of perfumery chemicals (K4)

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	2	1	2	1	2	2	3	2
CO2	2	3	2	2	3	2	3	2	3	3	3	2
CO3	2	3	2	3	2	3	2	3	2	3	3	2
CO4	2	2	3	2	2	3	2	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	30	30	30	30
Apply	20	20	20	20
Analyze	20	20	20	20
Evaluate	20	20	20	20
Create	0	0	0	0

Syllabus:

Module I

Introduction to nutraceuticals: definitions, synonymous terms, claims for acompound as neutraceutical, regulatory issues.

Module 2

Study of Properties, structure and functions of various Nutraceuticals, such as carotene, lycopene, omega fatty acids, phytosterolsetc, formulation of functional food, stability, analysis.

Module 3

Manufacturin aspects of selected nutraceuticals such as lycopene, iso flavonoids.

Module 4

Food as remedies, Anti-nutritional Factors present in Foods, Nutritional Genomics Nutraceutical Industry and Market Information,

Module 5

Nutraceuticals and the Future of Medical Science and Consumers views on nutraceuticals, Labeling and claims for Nutraceuticals products

Course contents and Lecture schedule:

S. No.	Topic	Reqd. hours
1.	Introduction to nutraceuticals: definitions, synonymous terms,	4
2.	Claims for a compound as neutraceutical, regulatory issues.	4
3.	Study of Properties, structure and functions of various Nutraceuticals, such as carotene, lycopene, omega fatty acids, phytosterolsetc,	5
4.	Formulation of functional food, stability, analysis.	4
5.	Manufacturing aspects of selected nutraceuticals such as lycopene, iso flavonoids.	4
6.	Food as remedies, Anti-nutritional Factors present in Foods,	4
7.	Nutritional Genomics Nutraceutical Industry and Market Information	5
8.	Nutraceuticals and the Future of Medical Science	4
9.	Consumers views on nutraceuticals, Labeling and claims for Nutraceuticals products	4
	Total	**38**

Reference Books:

1. Essentials of human nutrition by J. Mann and S. Truswell (2nd Edition, 2002), OxfordUniversity
2. Encyclopedia of human nutrition (1998) , London: Academic press
3. Modern nutrition in health and disease, 9th edition edited by Shils, Olson, Shike and Ross
4. Nutrional Biochemistry and \metabolism, 2nd edition edited by Linder (1991)

NOT: 417 FUELS AND GREEN LUBRICANTS

L:T: P:C
3 : 0: 0:3

Preamble

The subject deals with the study of different types of fuels and lubricants used in the industries. The basis of selection of fuels and lubricants along with the role of various additives is also discussed. The subject also includes information related to the quality parameters and method of production of lubricating oils and greases.

Prerequisite:

Fundamental knowledge of lubricating principles, oils & fats

Course Outcome:

CO1	Gain knowledge related to the fuels used in the industries	Understand
CO2	Understand the role & properties of lubricants and role of additives in the performance of lubricants	Understand
CO3	Perform analytical tests for assuring the quality of fuel	Analyze
CO4	Select the type of lubricant based on different applications	Apply
CO5	Develop formulations for natural & synthetic lubricating greases	Create

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

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	1	3	2	2	2	2	2	3	2
CO2	2	3	2	2	3	2	2	2	3	3	3	3
CO3	3	2	1	3	2	3	3	1	3	2	3	2
CO4	2	2	3	2	2	3	2	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Mapping with Program Outcomes

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	20	20	20
Apply	20	20	20	20
Analyze	30	30	30	30
Evaluate	20	20	20	20
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Different fuels used in the industry
2. Properties and industrial uses of different fuels.

Course Outcome 2(CO2)

1. Classification of lubricants
2. Additives and their role in lubricating oils.

Course Outcome 3(CO3)

1. Thermo chemistry of fuels
2. Test methods of fuels

Course Outcome 4(CO4)

1. Principle of lubrication.
2. Properties of lubricating oils.

Course Outcome 5(CO5)

1. Properties and types of lubricating greases
2. Additives used in lubricating greases.
3. BIS test methods of greases.

Syllabus

Module-I

Handling and storage of fuels

Fuels used in industry such as LDO, furnace Oil ,HSD, Gas, thermic fluid, coal, husk, briquets.

Module-II

Introduction to lubricants

Liquid, Solid and gas lubricants and their applications, Lubricating oils Synthetic lubricants. Physical properties, manufacture of lubricating oils.Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, classification of lubricating oils such as thermic fluids, gear oils, hydraulic oils etc, viscosity index improver.

Module-III

Properties of Fuels

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, distillation, vapour pressure, flash point, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point etc.

Module-IV

Lubricants

General aspects of lubrication, lubricant characteristics and types ,selection principle ,Lubrication in metal cutting, conditions of use for cutting fluids, coolants, gear oils.

Module-V

Lubricating Greases

Properties, types, ingredients, additives, analysis of lubricating oils and greases as per BIS test methods. Manufacture of lubricating Greases-Processes and equipments.

Reference Books:

1. Internal Combustion Engineering Edited by V. Ganesan. 2003
2. Lubrication and Lubricants, Edited by Eric R. Braithwaite (1967)
3. Lubricating Greases by C.J.Boner
4. Lubricating Oils by C.J.Boner

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Handling and storage of fuels**	
1.1	Handling and storage of LDO and HSD	2
1.2	Handling and storage of furnace Oil and thermic fluid	2
1.3	Handling and storage of Gas, coal, husk and briquets	2
2.	**Introduction to lubricants**	
2.1	Liquid, Solid and gas lubricants and their applications	2
2.2	Lubricating oils Synthetic lubricants	1
2.3	Physical properties and manufacturing of lubricating oils	1
2.4	Specific requirements for automotive lubricants	1
2.5	Oxidation deterioration and degradation of lubricants	2
2.6	Additives and additive mechanism such as viscosity index improver, pour point depressants	2
2.7	Classification of lubricating oils such as thermic fluids, gear oils, hydraulic oils etc.	2
3.	**Properties of Fuels**	
3.1	Thermo-chemistry of fuels	1
3.2	Properties and testing of fuels	1
3.3	Test methods for relative density, calorific value, distillation, vapor pressure	2
3.4	Test methods for flash point, spontaneous ignition temperature, viscosity, pour point	2
3.5	Test methods for flammability, ignitability, diesel index, API gravity, aniline point	2
4.	**Lubricants**	
4.1	General aspects of lubrication	1
4.2	Lubricant characteristics and types	1
4.3	Selection principle of lubricants	1
4.4	Lubrication in metal cutting, conditions of use for cutting fluids, coolants, gear oils	2
5.	**Lubricating Greases**	
5.1	Properties of lubricating greases	1
5.2	Types of lubricating greases	1
5.3	Ingredients and additives of lubricating greases	2

5.4	Manufacture of lubricating Greases-Processes and equipments.	2
5.5	Analysis of lubricating oils and greases as per BIS test methods.	2
	Total	**38**

NOT 419 Industrial Training

L : T: P:C
0 : 0 : 4 :2

Objective: Students are allotted to work as trainee in different industries of the field for a period of 6-8 weeks. The basic objectives are as follows:

1. To aware with the industrial environment, movement of raw materials upto finished products, human behavior, industrial relation, manpower management & efficient management of the manpower.
2. To have a proper knowledge of the manufacturing process of different products, their quality control procedure, utilities, and various techniques of quality control in terms of raw material, in process parameters and finished products as per norms of BIS, FSSAI and other statutory bodies.
3. To gain knowledge of water treatment, effluent treatment and air pollution control devices. Proper analysis of fuel and other utilities.
4. Students are allotted to work on project assign in that particular industries for controlling the losses, utilities consumption & other inputs for reducing cost of production.
5. To understand proper maintenance of the equipments in the plants, i. e. regular, preventive and other schedule maintenance.
6. To understand the stores activities of procurement, storage & issue of spare-parts, packaging materials and various consumables & raw materials get conversant with FIFO system.
7. To understand the industrial drawings like layout, P&ID, line diagrams, electrical & instrumentation, civil drawings.
8. The students must understand the costing of various inputs on different section basis so as to have a knowledge of total cost of production.
9. To understand the R&D activities being carried out by the industries or intent to carry by the company & share their knowledge.
10. They should also aware the applicable the tax structure.

Open Elective II

OOT 401 Technology of Soaps

L : T: P:C
2 : 0 : 0 :2

Preamble:

The course provides basic knowledge of Soaps, their raw materials and manufacturing processes apart from domestic and industrial applications. This also gives exposure of plant and machineries used for purification of raw materials, their importance, packaging and quality control.

Prerequisite:

Knowledge of various oils, fats and fatty materials for soap manufacture.

Course Outcome:

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

(CO1)	Have basic knowledge of various surface active agents, their effectiveness and applications.	Understand
(CO2)	Select raw materials on the basis of their properties on the requirementof finished products & testing of the raw materials.	Apply
(CO3)	Select method of Soap Manufacture, builders, fillers and additives &knowledge of the plant & machinery & maintenance of the same.	Apply
(CO4)	Evaluate quality of raw materials and finished products	Evaluate
(CO5)	Preparation of laundry & toilet soap in pilot project or in laboratory Assess process for saponification and develop formulation, to make it Cost effective, knowledge of pollutant produced in the industry & theirprocess.	Create

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	1	2	1	S	1	3	1
CO2	3	2	3	3	3	3	2	3	S	2	3	2
CO3	3	3	2	1	3	2	3	3	2	1	3	2
CO4	3	3	2	3	3	2	3	3	3	2	3	3
CO5	3	3	3	2	3	3	2	2	3	3	3	2

Assessment Pattern:

Bloom"s Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	20
Understand	10	20	20	20
Apply	20	20	20	20
Analyze	20	20	20	30
Evaluate	20	20	20	10
Create	20	10	10	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

4. Survey of raw materials for soap manufacture.
5. Knowledge of various types of soaps and their utility.
6. Knowledge of equipment and machineries

required.

Course Outcome 2(CO2)

4. Selection of builders and fillers based on required quality of end products.
5. Modification of raw materials for better quality.
6. Study of specifications of soaps and fatty acids as per BIS

standards

Course Outcome 3(CO3)

1. Selection of process for saponification & soap manufacture.
2. Maintenance, quality control and process cost.
3. Eco-friendly process adoption.

Course Outcome 4(CO4)

4. Selection criteria for plant and machineries.
5. Production of soap base by conventional and modern methods
6. Estimation of process cost like energy consumption, etc.

Course Outcome 5(CO5)

4. Assessment of ecofriendly processes of soap manufacture.
5. Acquiring knowledge of types of soaps like soft soap, liquid soaps, transparent soaps, medicated soaps, floating soaps, etc.
6. Study of various kinds of specialty soaps

Syllabus:

Module-I Fundamentals of soaps:

History and background of soaps, General principles of soap-making, chemistry of cleaning action in soaps. Study of saponification reaction, velocity and temperature. Raw material for soaps and their selection: role of INS factor, solubility ratio and hardness number, quality specifications and soap making properties of oils and fats.

Module-II

Modification and quality enhancement of household soaps:

Selection and functions of builders, fillers and other auxiliary raw materials, Classification of builders and their specifications according to BIS, Up-gradation of raw materials including fractionation, Manufacture of soaps from fatty acids & methyl esters, Specifications of soaps and fatty acids as per BIS standards.

Module-III

Machineries employed for household soap processing:

Machinery employed and quality specifications with emphasis on effect on quality of milling and plodding, Principles related to the production of extruded soaps-solidification and high shear reaction system, drying, extrusion, solid-solid co-extrusion, homogenization and plastic working.

Module-IV

Continuous processes of soap manufacture:

Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes, phase behavior, Production of soap base by traditional methods in single vessel, saponification in presence of catalysts and/or at high temperature and high pressure. Modern process and plant for the production of household and toilet soaps viz. Cascade, Mazzoni.

Module-V

Manufacture of specialty soaps:

Soft soaps, liquid soaps, transparent and translucent soaps, super fatted soaps, medicated soaps, floating soaps, multi colored soaps etc. Soap powders like spray-chilled and spray-dried powders.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Fundamentals of soaps**	
1.1.	History and background of soaps, chemistry of cleaning action	1
1.2.	General principles of soap-making	2
1.3.	Raw material for soaps and their selection	3
1.4.	Calculation of INS factor, solubility ratio and hardness number	2

2.	**Modification and quality enhancement of household soaps**	
2.1.	Selection and functions of builders, fillers and other auxiliary rawmaterials	3
2.2.	Classification of builders and their specifications according to BIS	2
2.3.	Up-gradation of raw materials including fractionation	2
2.4.	Manufacture of soaps from fatty acids & methyl esters	1
2.5.	Quality specifications and soap making properties of oils and fats	2
3.	**Machineries employed for household soap processing**	
3.1.	Machinery employed for soap manufacture	2
3.2.	Machinery for milling and plodding	1
3.3.	Production of extruded soaps-solidification and high shear reaction system, ,	2
3.4.	Drying, extrusion, solid-solid co-extrusion	2
3.5.	Homogenization and plastic working	1
4.	**Continuous processes of soap manufacture**	
4.1.	Production of soap base by traditional methods in single vessel	2
4.2.	Production of washing and toilet soaps from soap base by cold, semi-boiled and full boiled processes	2
4.3.	High shear reaction system	1
4.4.	Modern process and plant for the production of household and toilet soaps	2
4.5.	Cascade and Mazzoni processes for the production of household and toiletsoaps	2
5.	**Manufacture of specialty soaps**	
5.1.	Soft soaps, liquid soaps	2
5.2.	Transparent and translucent soaps	2
5.3.	Super fatted soaps, medicated soaps	2
5.4.	Floating soaps, multi coloured soaps	1
5.5.	Soap powders like spray-chilled and spray-dried powders	2
	Total	**44**

Text Books:

1. Bailey‟s Industrial Oil and Fat, Edition 6 Vol-1 (2005), Edited by FeireidoonShahidi, Wiley Interscience publication
2. Parasuram, K. S., (2002) Soaps and Detergents. Tata Macgraw Hill. (ISBN 007-462324-9)

Reference Books:

1. Chakrabarty, M.M., Chemistry and Technology of Oils and Fats. Allied Publishers Pvt.Ltd. New Delhi.
2. NIIR Board. The Complete Technology Book on Soaps (2nd Revised Edition)
3. Spitz, L. (2016). Soap Manufacturing Technology: Second Edition.

Web Links:

1. https://www.youtube.com/watch?v=iipY_DDuAeg
2. https://www.youtube.com/watch?v=ftzeM6xNY_M
3. https://www.youtube.com/watch?v=Tu_sWoHULtY

NOT 471 Minor Project

L : T: P:C
0 : 0 : 12 :6

Objectives

1. Students are expected to explore various relevant topics and come out with a specific startup proposal.

2. The students are expected to work on product and process development at lab scale.

NOT 473 Seminar

L : T: P:C
0 : 0 : 4 :2

The student will be required to prepare and deliver a seminar as well as submit a written report on the topic assigned to him/her

OUT COMES
1. This training provides a basic backbone for students for future industrial working environment.
2. Students after training gain a lot for appearing in campus placement activities.
3. Presentation enhances communication skill of the students

Year IV, Semester VIII
Programme Elective V

NOT: 402 Perfumery and Cosmetic Technology

L : T: P:C
3 : 1 : 0 :4

(CO1)	Understand various Perfumery and Cosmetic products	Understand
(CO2)	Isolate various Perfumery and Cosmetic products in various applications as per their physico-chemical properties	Analyze
(CO3)	Study of the components of perfumery and cosmetic products and their recoveryby different suitable process.	Apply
(CO4)	Synthesize and formulate various Hair Grooming Products for differentapplications.	Create
(CO5)	Formulate various Herbal cosmetic products for different applications.	Create

Mapping with Program Outcomes

CO3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2	1	2	1	3	3	3	2
CO2	2	2	2	2	2	3	2	1	3	1	3	2
CO3	2	3	2	2	2	2	1	2	2	1	3	3
CO4	3	3	3	2	3	3	2	3	3	3	3	2
CO5	3	3	3	3	3	2	3	3	3	2	3	3

Assessment Pattern:

Bloom‟s Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	20	10	20
Understand	20	30	20	20
Apply	20	10	20	20
Analyze	20	10	20	30
Evaluate	10	20	20	10
Create	10	10	10	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Sources and availability of raw material.
2. Classification, chemistry and structure of components.

Course Outcome 2(CO2)

1. Extraction technologies of essential oils
2. Instrumental analytical techniques of analysis of essential oils

Course Outcome 3(CO3)

1. Production techniques
2. Composition of various perfumery chemicals.

Course Outcome 4(CO4)

1. Production of synthetic Hair grooming products, Shampoos, Shaving soaps and creams.
2. Study of Skin anatomy
3. Application of herbs in cosmetics application, preservation
4. Advantages in perfumery.

Course Outcome 5(CO5)

1. Herbal Cosmetic preparations
2. Chemical components of herbs
3. Extraction
4. Application of herbs & its extracts

Unit I

Fragrance –raw materials

Plant Oils: Essential Oil, Flower Oil, Resin and gum exudation. Animal secretions, Chemical substance – isolates (Plant, derivatives of plant materials, synthetic organic substances.

Unit II

Newer extraction technologies

Raw materials for essential oils, newer extraction technologies of essential oils, Supercritical extraction, HFC extraction, Bio extraction etc. Instrumental analytical techniques of analysis of essential oils.

Unit III

Skin Preparations Facial makeup

Creams, Cleansing, emollient, hand and hormones Cream/lotions, foundation makeup , lipstick , sunscreen preparations.

Unit IV

Hair Preparations

Skin anatomy, raw materials and their selection, additives etc. for hair dyes, Bleaches, Hair coloring, hair fixatives, Hair grooming preparations. Hair Care: Shampoos, Shaving soaps and creams, pre-shave and aftershave preparation.

Unit V

Herbal Products

Herbal Cosmetic preparations; Chemical components of herbs & its extraction, Application of herbs & its extracts, Application of herbs in cosmetics application, preservation; Advantages in perfumery: Notes of perfume, compatibility of perfume , fixation and stability of perfume ; analysis of perfumes, Medicinal applications of herbal and other essential oils & perfumes.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Fragrance –raw materials**	
1.1	Plant oils: essential oil	2

1.2	Flower Oil, Resin and gum exudation	2
1.3	Animal secretions, Chemical substance – isolates (Plant, derivatives of plant materials, synthetic organic substances	4
2.	**Newer extraction technologies**	
2.1	Raw materials for essential oils	2
2.2	Raw materials for essential oils, newer extraction technologies of essential oils	2
2.3	Supercritical extraction, HFC extraction	1
2.4	Bio extraction	1
2.5	Instrumental analytical techniques of analysis of essential oils	2
3.	**Skin Preparations Facial makeup**	
3.1	Creams/lotions, sunscreen preparations	2
3.2	Cleansing agents	1
3.3	Emollient	1
3.4	Hand and hormones Cream	2
3.5	Foundation makeup , lipstick	2
4.	**Hair preparations**	
4.1	Skin anatomy, raw materials and their selection, additives	2
4.2	Bleaches, Hair coloring, hair fixatives	2
4.3	Hair grooming preparations. Hair Care: Shampoos, Shaving soaps and creams	2
4.4	Pre-shave and aftershave preparation	2
5.	**Herbal products**	
5.1	Herbal Cosmetic preparations	1
5.2	Chemical components of herbs & its extraction, Application of herbs & its extracts	2
5.3	Application of herbs in cosmetics application, preservation, Advantages in perfumery	2
5.4	Compatibility of perfume , fixation and stability of perfume	1
5.5	Analysis of perfumes, Medicinal applications of herbal and other essential oils & perfumes	2
	Total	**40**

Reference Books:

1. Perfume Cosmetics & Soaps Vol.-I –III by W.A. Poucher
2. Cosmetics Science & Technology Edition 2 Vol-II (1972 Edited By M.S. Balsam & Edward Sagarin)
3. Aroma Science – S. P. Gimelli
4. Fragrance Chemistry – E. T. Theimer
5. Perfumery and Flavoring synthetics – Bedaukian

NOT: 404 GREEN AND MODERN TECHNOLOLOGIES APPLIED IN OILS AND ALLIED PRODUCTS

L : T : P : C
3 : 1 : 0 : 4

Preamble:

The course provides necessary knowledge of Green technologies; applied in edible oil industries, ecofriendly processes of oil extraction, oil processing and oleochemical synthesis. Course also provides in depth knowledge of Biofuels and Biolubricants.

Prerequisite:

Students are required to have basic knowledge of green technology.

Course Outcome:

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

(CO1)	This gives exposure of green chemistry and green engineering, green reagents and catalysis in green synthesis.	Understand
(CO2)	Student will be exposed to various methods of green oilseed processing and oil extraction techniques.	Apply
(CO3)	This enables the students to come through the green processes of oil refining and oleochemical synthesis.	Apply
(CO4)	Understand various green surfactants, surface active agents and their derivatives.	Analyze
(CO5)	Apply their understanding of bio ethanol, biodiesel, bio-lubricants and their applications.	Analyze

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	1	1	3	3	1
CO2	1	2	2	1	1	3	1	1	1	1	3	1
CO3	2	3	2	2	2	2	1	3	2	2	3	1
CO4	3	3	2	2	3	3	2	2	3	3	3	1
CO5	3	3	3	3	3	3	3	3	3	3	3	1

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	20	10	20	20
Understand	20	30	20	20
Apply	0	20	20	10
Analyze	50	20	20	40
Evaluate	10	20	20	10
Create	0	0	0	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. General Principles of Green Chemistry and green engineering
2. Green reagents and catalysis in green synthesis
3. Designing green processes- safe design, process intensification, in process monitoring

Course Outcome 2 (CO2)

1. Cold Press extraction
2. Extraction of oils by using green solvents, Aqueous & enzymatic extraction
3. Ultrasconic, Microwave and Supercritical Fluid Extraction
4. Challenges and Benefits Green Extraction.

Course Outcome 3 (CO3)

3. Green process of oil refining
4. Green process of Synthesis of oleochemicals

Course Outcome 4 (CO4)

1. Green Surfactants and Biosurfactants
2. Nanobiotechnology in synthesis of green surfactants
3. Green corrosion inhibitors
4. Bioactive compounds related to surfactants

Course Outcome 5 (CO5)

1. Bio-fuel: Bio Ethanol, Biodiesel, Method of synthesis and application
2. Biolubricants: Method of synthesis and application

Syllabus:

Unit 1: Introduction and General Principal of Green Chemistry and Technology

General Principles of Green Chemistry and green technology, Green reagents and catalysis in green synthesis, Designing green processes- safe design, process intensification , in process monitoring

Unit 2: Green Technology in Oilseed Processing and Oil Extraction

Cold Press extraction, Extraction of oils by using green solvents, Aqueous & enzymatic extraction, Selection of enzymes for oil extraction, Factors affecting enzyme mediated oil extraction, Ultrasconic extraction, Microwave extraction, Supercritical Fluid Extraction, Challenges and Benefits Green Extraction.

Unit 3: Green Technology in Refining of Oil and oleochemicals

Zero waste refining, Bio refining Non-thermal refining by electric field, Deodorization by high voltage electric field, Production of bioemulsifiers, Enzymatic Fat Splitting

Unit 4: Green Technology in Surfactants and Surface Active Agents

Green Surfactants, Biosurfactants, Nanobiotechnology in synthesis of green surfactants, Green corrosion inhibitors, Bioactive compounds related to surfactants, glycolipid biosurfactants

Unit 5: Green Fuels and Green Lubricants

Bio-fuel: Bio Ethanol, Biodiesel, Method of synthesis and application, Biolubricants: Method of synthesis and application

Reference Books and suggested readings:

1. Green Vegetable Oil Processing, 1st Edition - December 4, 2013, **Editors:** Walter E. Farr, Andrew Proctor Paperback ISBN: 9780128102169, E-Book ISBN: 9780983057208
2. Green Chemistry – An introductory text - M. Lancaster, RSC
3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds), Wiley publications
4. Environmental chemistry _ Stanley E Manahan, Lewis Publishers
5. Baileys Industrial oil and fat products by Daniel Swern, Wiley Interscience publication (1979)

Course Objective:

The course provides introductory knowledge of Green technologies; applied in edible oil extraction, oil processing and oleochemical synthesis.

Course Outcome:

Students are well conversant with the basic knowledge of various Green technologies; applied in edible oil extraction, oil processing and oleochemical synthesis.

Course contents and Lecture schedule:

Module no.	Topic	No. of lectures
1.	**Introduction and General Principal of Green Technology**	
1.1.	General Principles of Green Chemistry and green engineering	2
1.2.	Green reagents and catalysis in green synthesis	2
1.3.	Designing green processes- safe design	2
1.4.	Process intensification and in process monitoring	2
2.	**Green Technology in Oilseed Processing and Oil Extraction**	
2.1.	Cold Press extraction	2
2.2.	Extraction of oils by using green solvents	2
2.3.	Aqueous & enzymatic extraction, Selection of enzymes for oil extraction	2
2.4.	Factors affecting enzyme mediated oil extraction	2
5.5.	Ultrasconic extraction, Microwave extraction, Supercritical Fluid Extraction	
6.	**Green Technology in Refining of Oil and oleochemicals**	
3.1.	Zero waste refining	2
3.2.	Bio refining Non-thermal refining by electric field	2
3.3.	Deodorization by high voltage electric field	2
3.4.	Production of bioemulsifiers	1
3.5.	Enzymatic Fat Splitting	1
4.	**Green Technology in Surfactants and Surface Active Agents**	
4.1.	Green Surfactants and Biosurfactants	2
4.2.	Nanobiotechnology in synthesis of green surfactants	2
4.3.	Green corrosion inhibitors, Bioactive compounds related to surfactants	2
4.4.	Glycolipid biosurfactants	2

5.	**Green Fuels and Green Lubricants**	
5.1.	Bio Ethanol: Method of synthesis and application	3
5.2.	Biodiesel: Method of synthesis and application	2
5.3.	Biolubricants: Method of synthesis and application	3
	Total	**40**

NOT: 406 INTRODUCTION TO PROCESSING TOOLS RELATED TO OIL PROCESSING

L : T: P:C
3 : 1 : 0 :4

Preamble:

This course introduces students to various processing tools utilized in the oil and allied industries. It covers accounting and data management tools, designing tools, automation tools, simulation tools, and the application of artificial intelligence (AI) and machine learning (ML).

Prerequisite:

Basic understanding of oil processing and related industries.

Course Outcome:

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

- (CO1) Utilize accounting and data management tools in the oil industry. **Understand**
- (CO2) Apply designing tools for process optimization and innovation. **Apply**
- (CO3) Implement automation tools for enhanced operational efficiency. **Apply**
- (CO4) Use simulation tools for modeling and analysis of processes. **Analyze**
- (CO5) Explore AI and ML applications in oil processing for improved decision-making and efficiency. **Evaluate**

Mapping with Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	1	2	1	2	2	3	2
CO2	3	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	2	3	2	3	2	3	2	3	3	3
CO4	2	2	3	2	2	3	2	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests	Terminal Examination
	1	2
Remember	10	10
Understand	20	20
Apply	20	20
Analyze	30	20
Evaluate	20	20

Create	0	10

Course Level Assessment Questions:

Course Outcome 1 (CO1)

1. Introduction to MS Office, SAP, Origin.
2. Applications of these tools in oil and allied industries.
3. Inventory control and data analytics.

Course Outcome 2 (CO2)

1. Design Expert: Basics and applications.
2. Stastica, Autocad: Overview and uses.
3. Chemcad, Chem draw: Introduction and industry relevance.

Course Outcome 3 (CO3)

1. Basics of PLC programming and SCADA.
2. Distributed control systems: Overview.
3. Applications in oil and allied industries.

Course Outcome 4 (CO4)

1. Introduction to Advanced Simulation Library.
2. Simulink, Aspen, Chemcad, Matlab: Basics and applications.
3. Simulation in oil processing.

Course Outcome 5 (CO5)

1. Introduction to AI: History and definitions.
2. AI techniques and applications.
3. AI in edible oil and allied industries: Uses and benefits.

Syllabus:

Module I: Accounting & Data Management Tools

Introduction to MS Office, SAP, Origin, Applications in oil and allied industries, Inventory control and Data Analytics

Module II: Designing Tools

Introduction to Design Expert, Stastica, Autocad, Applications in oil and allied industries, Chemcad, Chem draw overview

Module III: Automation Tools

Introduction to PLC programming, SCADA, Distributed control system,Programming logic control and applications in oil and allied industries

Module IV: Simulation Tools

Introduction to Advanced Simulation Library, Simulink, Aspen, Chemcad, Matlab, Applications in oil and allied industries

Module V: Application to Artificial Intelligence (AI) and Machine Learning (ML)

Introduction to AI: History, definitions, branches, and challenges, AI techniques: Search, knowledge representation, reasoning, planning, learning, and natural language processing, AI applications: Expert systems, decision support systems, computer vision, robotics, and machine learning, AI in edible oil and allied industries: Uses, benefits, limitations, and ethical issues

Reference Books:

1. "Introduction to MS Office," by Microsoft.
2. "SAP for Dummies," by Andreas Vogel and Ian Kimbell.
3. "OriginLab Guide," by OriginLab Corporation.
4. "Design Expert User Guide," by Stat-Ease, Inc.
5. "Stastica Handbook," by StatSoft, Inc.
6. "Autocad 2024 Tutorial," by Autodesk.
7. "Chemcad User Manual," by Chemstations, Inc.
8. "ChemDraw Guide," by PerkinElmer.
9. "PLC Programming Methods," by John Ridley.
10. "SCADA Explained," by William T. Shaw.
11. "Advanced Simulation Library," by ASL.
12. "Simulink Reference," by MathWorks.
13. "Aspen Plus User Guide," by Aspen Technology.
14. "Matlab Guide," by MathWorks.
15. "Artificial Intelligence: A Modern Approach," by Stuart Russell and Peter Norvig.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1	Introduction to accounting & data management tools	2
1.1	Introduction to MS Office, SAP, Origin	2
1.2	Applications in oil and allied industries	2
1.3	Inventory control and data analytics	2
2	Introduction to designing tools	2
2.1	Design Expert, Stastica, Autocad overview	2
2.2	Chemcad, Chem draw	2
2.3	Applications in oil and allied industries	2
3	Automation tools	2
3.1	PLC programming, SCADA basics	2
3.2	Distributed control system overview	2
3.3	Applications in oil and allied industries	2

4	Simulation tools	2
4.1	Advanced Simulation Library introduction	2
4.2	Simulink, Aspen, Chemcad, Matlab basics	2
4.3	Applications in oil processing	2
5	AI and ML in oil processing	2
5.1	AI: History, definitions, and branches	2
5.2	AI techniques and applications	2
5.3	AI in edible oil and allied industries	2
Total		30

Open Elective III

OOT 402 Technology of Surface Active Agents

L : T: P:C
2 : 0 : 0 :2

Preamble:

The subject deals with the study of surface active agents, their classification, method of production, industrial applications,environmental impact of the detergent products.

Prerequisite:

Fundamental knowledge of fatty acid composition of oils.

Course Outcome:

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

(CO1)	Understand the role of surface active agents in day to day life	Understand
(CO2)	Apply the knowledge acquired in professional career for serving the industry	Apply
(CO3)	Use the knowledge to establish small scale enterprises	Apply
(CO4)	Use the knowledge to develop suitable formulations of detergent products	Evaluate
(CO5)	Evaluate the performance and impact of the detergent products on the environment	Evaluate

Mapping with Program Outcomes

CO3	PO1	PO3	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO13
CO1	2	2	3	1	2	1	2	1	2	2	3	2
CO3	3	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	2	3	2	3	2	3	2	3	3	3
CO4	2	2	3	2	2	3	2	2	2	2	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	4
Remember	10	10	10	10
Understand	20	20	20	20
Apply	20	20	20	20
Analyze	30	20	20	30
Evaluate	20	20	20	20
Create	0	10	10	0

Course Level Assessment Questions:

Course Outcome 1(CO1)

1. Definition and role of surface active agents.
2. Effect of surfactants on the interfaces
3. Bulk properties and their measurement.

Course Outcome 2(CO2)

1. Chemistry and route of synthesis of anionic surfactants and their applications

2. Chemistry and route of synthesis of cationic surfactants and their applications
3. Chemistry and route of synthesis of nonionic surfactants and their applications
4. Chemistry and route of synthesis of amphoteric surfactants and their applications

Course Outcome 3(CO3)

1. Plants and machineries for production of anionic surfactants
2. Plants and machineries for production of cationic surfactants
3. Plants and machineries for production of nonionic surfactants

Course Outcome 4(CO4)

1. Role of builders in detergent product formulations
2. Production of detergent powders
3. Production of detergent cakes

Course Outcome 5(CO5)

1. BIS analysis of detergent products
2. Environmental impact of surfactants and builders
3. Performance evaluation of detergent products

Syllabus

Module- I

Introduction to surface active agents; effect and behavior of surface active agents on the interfaces; solid-liquid, gas-liquid, liquid-liquid and interfaces formed by three phases e.g. solid, liquid and gas and two immiscible liquids.

Module –II

Anionic surfactants: sulfated and sulfonated surfactants, Cationic surfactants: Non-quaternary nitrogen bases e.g. amines, nitriles and miscellaneous cationic surfactants. Nonionic surfactants: Poly-ethoxy ethers and esters and poly-hydroxy nonionic surfactants. Amphoteric surfactants.

Module –III

Anionic surfactants viz. alcohol sulfates, alkyl aryl sulfonates, olefin sulfonates, sulfated and sulfonated oils, alpha methyl esters etc., non ionic surfactants viz. Poly-ethoxy ethers and esters, poly-hydroxy surfactants etc. and cationic surfactant e.g. quaternary ammonium compounds.

Module –IV

Inorganic and organic builders and fillers, polymers, optical brighteners, enzymes and other performance additives used in the manufacture of synthetic detergents and their functions.

Module –V

Various physical forms of synthetic detergents: Solid, liquid, and non/liquid forms. Plants and processes employed for manufacture of powder, liquid, cake andother forms.

Reference Books

1. Sulphonation Technology In The Detergent Industry, Herman W. and De Groot,Springer-Verlag New York.
2. Surface Active Agents , Goliath Company,The Gale Group, USA
3. Synthetic Detergents,. Davidson, A.,and Mılwidsky, B.M.,John Willey Sons,New York.
4. Handbook Of Detergents, Waldhoff, H.,and Henkel K.CRC Press, USA.
5. The Manufacture of Soaps, Other Detergents, and Glycerine,Woollatt, Edgar,Mountainview Books, PA, U.S.A.
6. Detergent Of Speciality Surfactants,Ed, Fredil,F.E.,Marcel Dekker, Inc.New York.
7. Handbook of Detergents,Edited by Uri Zoller,CRC Press,London.

Course contents and Lecture schedule:

Module No.	Topic	No. of Lectures
1.	**Module- I**	
1.1	Introduction to surface active agents: Theory of surface action; effect and behavior of surface active agents on the	2
1.2	Interfaces; solid- liquid, gas-liquid, liquid-liquid	2
1.3	Interfaces formed by three phases e.g. solid, liquid and gas and two immiscible liquids	2
2.	**Module- II**	
2.1	Anionic surfactants: sulfated and sulfonated surfactants	2
2.2	Cationic surfactants: Non-quaternary nitrogen bases e.g. amines, nitriles and their: quaternary nitrogen bases and miscellaneous cationic surfactants	2
2.3	Nonionic surfactants: Poly-ethoxy ethers and esters and poly-hydroxy nonionic surfactants	2
2.4	Amphoteric surfactants	2
3.	**Module- III**	
3.1	Anionic surfactants viz. alcohol sulfates, alkyl aryl sulfonates, olefin sulfonates, sulfated andsulfonated oils, alpha methyl esters etc	2
3.2	Non ionic surfactants viz. Poly-ethoxy ethers and esters, poly-hydroxy surfactants etc	2
3.3	Cationic surfactant e.g. quaternary ammonium compounds.	2
4.	**Module- IV**	
4.1	Inorganic and organic builders and fillers	2

4.2	polymers, optical brighteners, enzymes	2
4.3	other performance additives used in the manufacture of synthetic detergents and their functions	2
5.	**Module- V**	
5.1	Various physical forms of synthetic detergents: Solid, liquid, and non/liquid forms.	2
5.2	Plants and processes employed for manufacture of powder, liquid, cake and other forms	2
	Total	**30**

NOT492 Project

L : T: P:C
0:0 :24 :16

Objectives

1. Specific topic for project are allotted to students to explore the possibilities of entrepreneurships development right from literature survey, raw materials availability, process and product feasibility, plant & machinery suppliers, cost analysis, marketing strategy etc.

2. Students make use of their knowledge and skills in the dissertation, techno-economic feasibility study, financial analysis. They implement their entire technical & commercial talent for the project.

3. Equipment design enables use of unit operation principles.

Outcomes:

The students are aware of MSME (Micro Small Medium Enterprises) entrepreneurships