

Syllabus for Bachelor of Technology
(B.Tech. in OILS OLEOCHEMICALS AND
SURFACTANT TECHNOLOGY)
(Under the New Education Policy-NEP 2020)
In
(2023-2024)



**INSTITUTE OF CHEMICAL
TECHNOLOGY**

(University Under Section-3 of UGC Act,
1956)

Elite Status and Center for Excellence
Government of Maharashtra

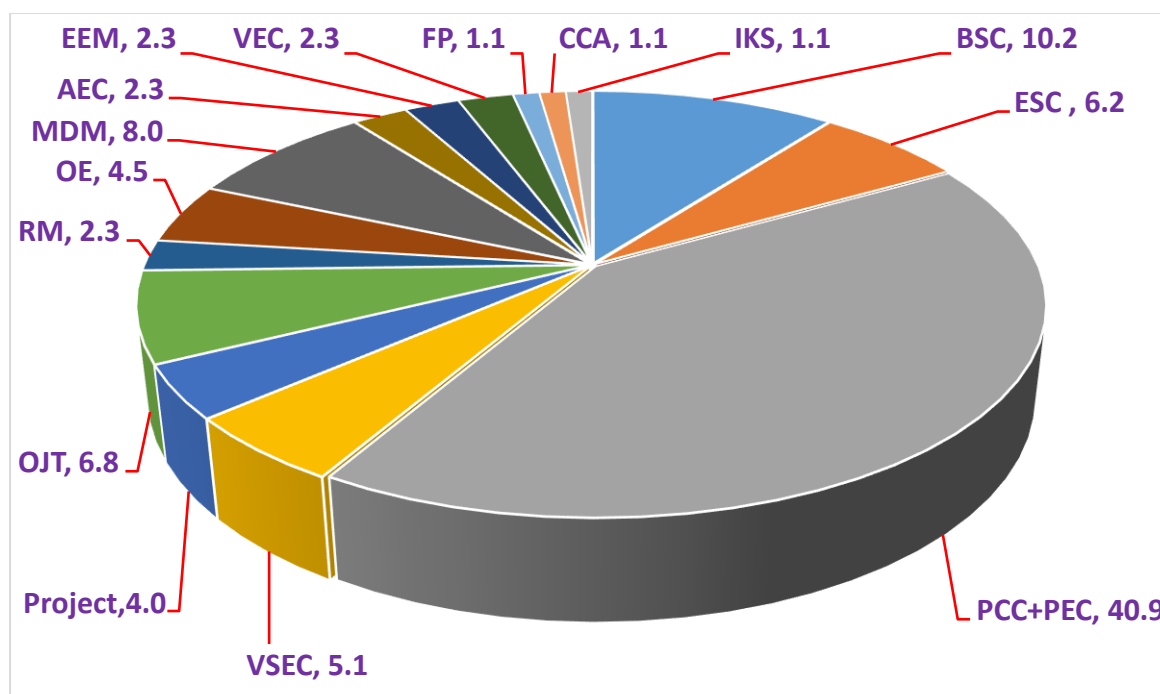
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DEPARTMENT OF OILS OLEOCHEMICALS AND SURFACTANT TECHNOLOGY

Preamble:

The undergraduate programmes at the Institute of Chemical Technology are reputed worldwide. Alumni from these programmes have found a place of pride in the Indian chemical industry including some top names and many as entrepreneurs, in Universities/ Institutes and Research Organisations throughout India and the world. The B.Tech. programmes in the then Department of Chemical Technology, University of Mumbai started in 1934 as post B.Sc., second graduation as B.Sc.(Tech.). Keeping national, societal needs in focus, post-independence, the programme grew into multiple branches keeping connection with chemical engineering content. Once the Institute became a University in 2009, these became independent B. Tech. Programmes retaining their dual core nature. The Institute of Chemical Technology is committed to keeping its syllabi updated and globally relevant for the industry. We have revamped the syllabi of all the B. Tech. programmes now in 2023 as per NEP 2020. The 176 credit programme each has following Credit Distribution



This does not include Honors courses of 18 credits.

All the courses are credit based and the evaluation are grade based. The credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits is based on student workload, learning outcomes and contact hours. This system is described in detail in Regulation No.9 of the Institute. Each theory course consists of Lectures and tutorials. During tutorial session, it is expected that the problem solving / case studies / relevant real life applications / student presentations / home assignments/individual or group projects are discussed in the presence of the teacher. Teacher can have the freedom to interchange lectures / tutorials depending upon the topic. Institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's) for

B. Tech. (OILS OLEOCHEMICALS AND SURFACTANT TECHNOLOGY.)

- PEO-1:** The graduates of the department are expected to think critically, creatively and apply the fundamentals of Oil Technology, surfactant technology, oleochemical technology to chemical and allied industries for the benefit of country in general, economy, society and environment in particular
- PEO-2:** Our graduates are expected to adopt to latest technologies and stay in tune with current needs of the country and society
- PEO-3:** Our graduates are expected to work for implementation of newer and better technologies for the benefit of mankind in general, economy, society & environment in particular
- PEO-4:** Our graduates are expected to be innovative and have good entrepreneurship and project management skills

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** 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.

B. PROGRAM SPECIFIC OUTCOMES (PSOs)

1. **Pursue Higher Studies:** Instill enthusiasm and motivation to go for advance studies and research so that graduates could develop themselves into Academician and Research scientists making positive contribution to generation and dissemination of new knowledge.
2. **Entrepreneurs & Corporate Employees:** Develop a confident graduate who can plan for innovative start-up career options or can offer solutions to the complex problems in Oils, Oleochemicals and surfactants field.

Graduate Attributes

1. Problem analysis and solving skills
2. Familiar with usage of modern tools, techniques
3. Communication Skills
4. Capacity to analyze new concepts
5. Capacity to analyze and interpret experimental data Capacity to analyze business trends
6. Capacity to design, optimize and operate equipment and plants safely, economically and effectively
7. Design and Development of solutions to industrial and societal needs
8. Skills related to Project Management and Economics
9. Skills to analyze scientific literature including patents
10. Ethics

Syllabus Structure for B. Tech Course

SEMESTER- I

Course Code	Subjects	Course Type	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	C.A.	M.S.	E.S.	Total
CHT1405	Physical Chemistry	BSC	3	2	1	0				
CHT1406	Analytical Chemistry	BSC	3	2	1	0				
MAT1205	Engineering Mathematics	ESC	3	2	1	0				
PYT1205	Applied Physics	BSC	2	1	1	0				
GET1305	Engineering Graphics and Computer Aided Drawing	VSEC	3	1	0	4				
OLT1101	SPL1 : Chemistry of Oils and Fatty Acids	ESC	2	1	1	0				
PYP1101	Physics Laboratory	BSC	2	0	0	4				
HUT1110B	Communication Skills(English)	AEC	2	0	0	4				
	OPEN Activity - Sports/ Fine arts/Yoga/ Music/NSS**	CCA	2	0	0	4				
	TOTAL:		22	9	5	16				

SEMESTER- II

Subject Code	Subjects	Course Type	Credits	Hrs/week			Marks for various Exams			
				L	T	P	C.A.	M.S.	E.S.	Total
CHT1407	Organic Chemistry	BSC	3	2	1	0				
CHT1408	Industrial Chemistry	BSC	3	2	1	0				
OLT1103	SPL-2: Nutrition	PCC	2	1	1	0				
GET1306	Basic Mechanical Engineering	ESC	2	1	1	0				
GET1125	Electrical Engineering and Electronics	ESC	2	1	1	0				
CEP1720	Process Calculations	ESC	2	0	0	4				
CHP1343	Physical and Analytical Chemistry Laboratory	BSC	2	0	0	4				
CHP1132	Organic Chemistry Laboratory	VSEC	2	0	0	4				
	OPEN Activity- Sports/ Fine Arts/Yoga/ Music/NSS**	CCA	2	0	0	4				
	MOOC- Indian Knowledge System (NPTEL - Introduction to Ancient Indian Technology)	IKS	2	0	0	4				
	TOTAL:		22	7	5	20				

Note: Universal Human Values (UHV) an audit course to be taken in inter-semester break after Semester-II to be taken as MOOC course.

** Students will undertake these co-curricular activities such as sports / Fine Arts / Yoga / Music / Literature etc administered through various clubs under Technological Association approved by Dean, Students Affairs.

SEMESTER- III										
Subject Code	Subjects	Course Type	Credits	Hrs/week			Marks for various Exams			
				L	T	P	C.A.	M.S.	E.S.	Total
OLT1102	SPL-3: Chemistry of Oleochemicals and Surfactant	PCC	4	3	1	0				
OLT1104	SPL-4 Chemistry of Essential Oils, and Their Application	PCC	2	1	1	0				
OE	From Basic Sciences (Chemistry/ Physics/Biology / Maths / Humanities)	OE	4	3	1	0				
	Communication Skills – (Marathi / Hindi or Any other language will be chosen using MOOCS)	AEC	2	1	1	0				
HUT1205	Basic Economics and Finance	EEM	2	1	1	0				
	Digital Computation in Emerging Areas (NPTEL course: Introduction To Industry 4.0 And Industrial Internet Of Things)	VEC	2	0	0	4				
	MDM-I: From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	1	1	0				
OLT1201	Pr 1: Lab-I: Analysis of Oilseeds, Oils and Raw Materials of Oils and Soap Industry	PCC	2	0	0	4				
OLP1217	Pr 2: Lab 2: Preparation and Purification of Organic Derivatives	PCC	2	0	0	4				
	TOTAL:		22	11	7	8				

SEMESTER- IV										
Subject Code	Subjects	Course Type	Credits	Hrs/week			Marks for various Exams			
				L	T	P	C. A.	M.S.	E. S.	Total
CET1105	Transport Phenomena	PCC	4	3	1	0				
OLT1111	SPL-5: Nutraceuticals	PCC	3	2	1	0				
OLT1108	SPL-6: Technology of Perfumery Chemicals	PCC	3	2	1	0				
OE	From Basic Sciences (Chemistry/ Physics/ Biology / Maths) or Humanities Discipline	OE	2	1	1	0				
CET1805	Chemical Process Economics	EEM	2	1	1	0				
HUT1206	Environmental Sciences and Technology	VEC	2	1	1	0				
	MDM II: From Sciences and/or any other Engineering /Humanities	MDM	2	1	1	0				
	Community Projects#	CEP/F P	2	0	0	4				
OLP1204	Pr3: Lab-3:Analysis of Surfactants	VSEC	2	0	0	4				
	TOTAL:		22	11	7	8				

Students will undertake community projects as individual or group related to study of societal technological activities through various organization such as Lions club, Teach India, Marathi Vidnyan Parishad, CSR projects outsourced by various industries, ISR activities administered through Technological Association approved by the Dean, Student Affairs.

SEMESTER- V

Subject Code	Subjects	Course Type	Credits	Hrs /week			Marks for various Exams			
				L	T	P	C. A.	M.S.	E. S.	Total
CET1806	Chemical Reaction Engineering	PCC	2	1	1	0				
CET1807	Chemical Engineering Operations	PCC	2	1	1	0				
OLT1105	SPL-7: Technology of Oil & Fat Production And Edible Oil Processing	PCC	4	3	1	0				
OLT 1117	Offered by the department/MOOCs :one of the electives can be : SPL8: Spectroscopy of Organic Molecules (OLT 1117)	PEC	4	3	1	0				
OE	From Basic Sciences (Chemistry/ Physics/ Biology / Maths) or Humanities Discipline	OE	2	1	1	0				
OLT1114	Honors Course -I: Byproducts Utilization and Waste Management (Subject code : OLT1114)	PCC	4	3	1	0				
	MDM III: From Sciences and/or any other Engineering / Humanities Discipline	MDM	4	2	0	4				
OLP1212	Pr5: Lab-4:Essential Oil Laboratory	PCC	2	0	0	4				
OLP1204	Pr4: Lab-5 : Evaluation and Testing of Soaps and Detergents	PCC	2	0	0	4				
	TOTAL:		26	14	6	12				

SEMESTER- VI

Subject Code	Subjects	Course Type	Credits	Hrs/week			Marks for various Exams			
				L	T	P	C.A.	M.S.	E. S.	Total
OLT1107	SPL-9: Cosmetics Science	PCC	3	2	1	0				
OLT1106	SPL-10: Production and Applications of Soaps, Surfactants and Detergents	PCC	3	2	1	0				
	Offered by the department/MOOCs :one of the electives can be SPL-11 : Supramolecular Chemistry of Nanomaterials (Subject code : OLT1109)	PEC	4	3	1	0				
OLT 1110	SPL-12: Technology of Drying Oils and Resins	PCC	4	3	1	0				
OLT1126	Honors Course-II: Modern Analytical Techniques	PCC	4	3	1	0				
	MDM IV: From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	1	1	0				
CEP1714	Chemical Engineering Laboratory	VSEC	2	0	0	4				
OLP1202	Pr6: Lab -6: : Processing of Oleochemicals& Waxes and Cosmetics Formulations	PCC	2	0	0	4				
OLP1206	Pr7: Lab -7: Paint Technology Laboratory	PEC	2	0	0	4				
	TOTAL:		26	14	6	12				

SEMESTER- VII

Subject Code	Subjects	Course Type	Credits	Hrs/week			Marks for various Exams			
				L	T	P	C. A.	M.S.	E.S.	Total
OLT1115	SPL-13: Petroleum Technology	PCC	3	2	1	0				
OLP1112	SPL-14: Technology of Oleochemicals	PCC	2	1	1	0				
	Offered by the department/MOOCs (one of the electives can be Product Management (Subject code : OLT1119))	PEC	3	2	1	0				
	Offered by the department/MOOCs (one of the electives can be New Product Development (Subject code : OLT1120))	PEC	2	2	0	0				
OLT1127	Honors-III: Optimization Techniques	PCC	4	3	1	0				
	MDM V: From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	1	1	0				
OLT1130	Literature Review (Research Methodology - I)	RM-1	2	1	0	2				
OLP1219	Design and Analysis of Experiments (Research Methodology - II)	RM-2	2	1	0	2				
OLP1216	Project -I (Literature search + Expt)	Project	4	0	0	8				
OLP1210	Pr8: Processing of Soaps, Detergents & Surfactants	PCC	2	0	0	4				
	TOTAL:		26	13	5	16				

SEMESTER- VIII

Semester-VIII (10 weeks)

Subject Code	Subjects	Course Type	Credits	Hrs /week			Marks for various Exams			
				L	T	P	C.A.	M.S.	E. S.	Total
OLT1113	SPL-15: Functional Fluids and Performance Chemicals	PCC	3	5	1	0				
OLT1128	Honors Course-IV: Alternative Fuels and Energy	PCC	3	5	1	0				
OLT1129	Honors Course-V: Biobased Materials	PCC	3	5	1	0				
	MDM VI: From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	2	1	0				
OLP1209	Project-II (Experiments)	PCC	3	0	0	12				
OLP1218	Pr9: Lab-8: Tribo-applications Laboratory	PEC	2	0	0	6				

Semester-VIII (12-16 weeks)

	Internship with Industry	OJT	12	0	0	0				
	Total		28	17	4	18				

Internship

- In the Eighth semester, every student will have to undergo an internship and/or On Job Training. The Internship would be of 12 credits.
- The internship would be assigned to the student by the Departmental Internship Coordinator, with the approval of Head, Chemical Engineering Department.
- The total duration of the internship would be for a period equivalent to 12 Calendar weeks. The internship may be completed in one or more organizations as described below.
- The internship could be of the following forms:
- Industrial internship in a company (within India or Abroad) involved in R&D / design / manufacturing (QA/QC/Plant Engineering/Stores and Purchase) / marketing / finance / consultancy / Technical services / Engineering / Projects, etc.
- At the end of the internship, each student will submit a written report based on the work carried out during the Internship. The report will be countersigned by the Supervisor from Industry / Institute as the case may be.
- Performance of the student will be assessed based on the written report and a presentation to a committee consisting of two faculty members from the Chemical Engineering Department.
- Students will be assigned a grade based on the written report and a presentation; evaluated by a committee of faculty members.
- Feedback will be taken from Industry mentors and this will used while assigning the grades.

BSC: Basic Science Course,
 ESC: Engineering Science Course
 PCC: Program Core Course, PEC: Program Elective Course
 MDM: Multi-disciplinary Minor: Different discipline of engineering or different faculty altogether
 OE: Open Elective: To be chosen Compulsorily from faculty other than major discipline
 VSEC: Vocational and Skill Enhancement Course: Hands on training corresponding to major/minor
 AEC: Ability Enhancement Course: English 2 credit, Modern Indian Language 2 credit
 IKS: Indian Knowledge System: Indian Architecture/Maths/Medicine
 VEC: Value Education Course: e.g. Understanding India, Environmental Science / Education / Digital and Tech solutions
 RM: Research Methodology
 CCA: Co-curricular activities: Health and wellness / Yoga / Sports / Cultural activities / NSS/NCC/Applied visual performing arts

EXIT Policy

Based on the National Education Policy guidelines, the students have an option of exiting at each level of their four year program. Student will get certificate after 1st year, diploma after second year and B.Sc (Tech/Engg) after third year.

Sr. No.	Exit Year	Activity	Credits	Duration (No of Weeks)
1	1 st Year (After Semester II)	8 credit course workshop/chemistry lab (after semester 2)	8	8 weeks
2	2 nd Year (After Semester IV)	Certificate Course in Practice of Chemical Technology (CCPCT)	8	8 weeks
3	3 rd Year (After Semester VI)	In-plant training	8	8 weeks

Semester-I

BSC	Course Code: CHT1405	Course Title: Physical Chemistry	Credits = 3		
	Semester: I		Total Contact Hours: 45	L	T
			2	1	0
List of Prerequisite Courses					
Standard XII Chemistry					
List of Courses where this course will be Prerequisite					
Physical and Analytical Chemistry laboratory , other multidisciplinary courses on Chemistry / Chemical Engineering.					
Description of relevance of this course in the B. Tech. Programme					
The course will enable the students to understand and apply the principles of thermodynamics to real-world systems. The students would be able to apply the insights to understand the stability of solutions, spontaneity of physical/chemical processes, effect of thermodynamics parameters on phase and chemical equilibria, etc.					
Sr. No.	Course Contents (Topics and Subtopics)				Required Hours
1	Laws of thermodynamics – a) Enthalpy and heat capacities, application of first law to gases, thermochemistry- Hess law b) Statements and applications of second law of thermodynamics, Clausius inequality, entropy as a state function, entropy changes for reversible and irreversible processes, entropy and probability c) Third law of thermodynamics, absolute entropies, verification of third law				6
2	Spontaneous process and equilibrium –Helmholtz and Gibbs free energy, spontaneity and free energy, Maxwell’s relations, effect of T and P on free energy,				3
3	Multicomponent system – free energy and entropy of mixing, partial molar quantities and chemical potential, Gibbs Duhem equation				6
4	Equilibrium in solutions – ideal and non ideal solutions, Henry’s law and Raoult’s law, colligative properties, activity and activity coefficients, thermodynamic properties of electrolytes in solution				7
5	Solubility equilibria – solubility constant, common ion effect, effect of added salts on solubility pH, weak and strong acids and bases, buffer solutions, ionic solutions Chemical Equilibria – Le Chatelier’s principle, Effect of temperature, pressure and composition on equilibrium				5
6	Introduction – concept of reaction rates and order, experimental methods in kinetic studies, differential and integral methods to formulate rate equations of zero, first and second order reactions Experimental methods of kinetic studies				3
7	Kinetics and reaction mechanism – rate determining step, steady state approximation Complex reactions - parallel, consecutive and reversible reactions Mechanism of thermal, photochemical chain reactions, polymerization reactions Fast reactions – experimental techniques				6
8	Homogenous catalysis – homogeneous acid / base catalysis (specific and general acid catalysis), enzyme catalysis (Michelis Menten kinetics)				6
9	Reactions at interface – Adsorption isotherms, kinetics of surface reactions- Hishelwood and Rideal models of surface reactions				3
Total					45
List of Text Books/Reference Books					
1	Atkins, Peter W.; Paula, Julio de; Keeler, James. Atkin’s Physical Chemistry; 11 th ed.; Oxford University Press (2018)				
2	Elements of Physical Chemistry (7th edition) by P. W. Atkins and J. de Paula, Oxford University Press, 2016.				

3	Chemical Kinetics (3rd edition) by Keith J. Laidler, New York : Harper & Row, 1987.
Course Outcomes (Students will be able to.....)	
CO1	<i>Elements of Physical Chemistry</i> (7 th edition) by P. W. Atkins and J. de Paula, Oxford University Press, 2016.
CO2	<i>Physical Chemistry</i> (6 th edition) by Ira Levine, McGraw-Hill Education, 2009
CO3	Elucidate the effect of thermodynamic quantities on chemical equilibria and relate it to properties of chemical systems
CO4	Comprehend fundamental knowledge in chemical kinetics with basics of order, molecularity and temperature effect
CO5	Examine kinetics for complex, fast as well as surface reactions and comprehend different theories in kinetics

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	1	3	0	3	2	2	2	3
CO3	K3	3	3	1	2	2	0	3	3	2	3	3	2	3	3
CO4	K2	2	2	0	2	0	3	3	3	3	3	3	1	2	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

BSC	Course Code: CHT1406	Course Title: Analytical Chemistry			Credits = 3		
		L	T	P			
	Semester: I	Total Contact Hours: 45			2	1	0
List of Prerequisite Courses							
Standard XII Chemistry							
List of Courses where this course will be prerequisite							
Physical and Analytical Chemistry Laboratory , other Chemistry Courses							
Description of relevance of this course in the B. Tech. Program							
The course introduces the students to key concepts of chemical analysis – sampling, selection of analytical method and data analysis. It presents basic techniques like spectroscopy and chromatography. The students should be able to select an appropriate analytical technique and apply it in accordance with its strengths and limitations.							
Sr. No.	Course Contents (Topics and Subtopics)						Required Hours
1	Introduction to chemical analysis, terminology (technique / method / procedure / protocol), broad classification of analytical techniques, good laboratory practices						5
2	Criteria for selecting analytical methods – accuracy, precision, sensitivity, selectivity, and detection limit Calibration and validation						8
3	Data analysis: errors – systematic and random errors, statistical treatment of experimental results (F, Q and t tests, rejection of data, and confidence intervals), least square method, correlation coefficients						6
4	Spectroscopic methods: General principle, instrumentation and applications of - UV-visible spectroscopy - Infrared spectroscopy - fluorescence spectroscopy						8
5	Electrochemical methods: General principle, instrumentation and applications of - Conductometry - Potentiometry						8
6	Chromatographic methods: General principle, instrumentation and applications of - Gas chromatography (GC) - HPLC						10

Total		45
List of Textbooks/Reference Books		
1	David Harvey. Modern Analytical Chemistry; McGraw-Hill (1999)	
2	R. A. Day and A. L. Underwood. Quantitative Analysis, Prentice Hall of India (2001)	
3	H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle. Instrumental Methods of Analysis, 7 th ed.; Wadsworth Publishing, USA (2004)	
4	D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch. Fundamentals of Analytical Chemistry; 9 th ed.; Cengage Learning (2013)	
5	D. A. Skoog, F. James Holler and S. R. Crouch. Principles of Instrumental Analysis; 6 th ed.; Cengage Learning (2016)	
Course Outcomes (Students will be able to.....)		
CO1	apply the knowledge of sampling, data analysis and select proper analytical method. (K3)	
CO2	explain the principles of UV Visible and Fluorescence spectroscopic methods. (K2)	
CO3	explain the principles of electrochemical methods. (K2)	
CO4	Understand the principles of chromatographic separations. (K2)	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	0	3	3	0	2	3	3
CO2	K2	3	1	0	1	1	0	3	3	2	3	3	0	2	2
CO3	K2	3	2	1	2	0	3	3	3	3	2	3	1	3	2
CO4	K2	3	2	1	1	1	3	2	3	3	3	3	1	1	2
Course	K3	3	2	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

ECS	Course Code: MAT1205	Course Title: Engineering Mathematics	Credits = 3		
	Semester: I		L	T	P
		Total Contact Hours: 45	2	1	0
List of Prerequisite Courses					
HSC Standard Mathematics					
List of Courses where this course will be prerequisite					

This is a basic Mathematics course. This knowledge will be required in almost all subjects later.

Description of relevance of this course in the B. Tech. Program

Applied Mathematics is beyond crunching numbers. It is useful for solving real-life problems and make an impact in the world, technology being one of those fields. The knowledge gained is required for solving various mathematical equations in several Chemical Engineering courses such as MEBC, Momentum Transfer, Reaction Engineering, Separation Processes, Thermodynamics, and several others.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Linear Algebra: Vectors in \mathbb{R}^n , Notion of linear independence and dependence. Vector subspaces of \mathbb{R}^n , Basis of a vector subspace, Row space, Null space, and Column space, Rank of a matrix, Determinants and rank of matrices Abstract vector spaces, Linear transformations in \mathbb{R}^n , Matrix of a linear transformation, Change of basis and similarity, Rank-nullity theorem, and its applications Inner product spaces, Orthonormal bases, Gram-Schmidt orthogonalization process, Eigenvalues and eigenvectors, Characteristic polynomials, Eigenvalues of special orthogonal projection and its application to least methods Diagonalization of matrices and its applications stochastic matrices, Solving initial value system of linear ordinary differential equations	10
2	Differential Calculus: Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, Convexity of functions, Radius of Curvature. Functions of two or more variables, Limit and continuity, Partial differentiation, Total derivatives, Taylor's theorem for multivariable functions and its application to error calculations, Maxima/Minima	11
3	Integral Calculus: Beta and Gamma functions, Differentiation under the integral sign, Multiple integrals, Line and surface integrals, Applications of Green's, Gauss-Divergence and Stokes theorems	11
4	Probability & Statistics: Random variables and cumulative distribution function, Probability mass function and probability density function, Some common univariate distributions: Binomial, Poisson, Uniform, exponential, Normal, Expectation and Moments, Moment generating function, Multiple random variables and Joint distribution, Marginal distributions, Covariance and Correlation Concept of parameter estimation: Maximum likelihood estimation, Method of least squares and Simple linear regression, Nonlinear regression	13
Total		45

List of Textbooks/Reference Books

1	Stang, G. Linear Algebra and its Applications; 4 th ed.; Thomson (2006)
2	Anton, Howard; Kaul, Anton. Elementary Linear Algebra; 12 th ed.; Wiley (2019)
3	Friedberg, Stephen H.; Insel, Arnold J.; Spence, Lawrence E. Linear Algebra; 5 th ed.; Pearson Education (2019).
4	Hughes-Hallett, Deborah; Gleason, Andrew M.; McCallum, William G. Calculus: Single and Multivariable; 6 th ed.; John Wiley & Sons, Inc. (2012)
5	Kreyszig, E.; Advanced Engineering Mathematics; 10 th ed.; Wiley Global Education (2010) (Officially Prescribed)
6	Iyengar, S. R. K.; Jain, R. K. Advanced Engineering Mathematics; 4 th ed.; Alpha Science (2014)
7	Ross, Sheldon M. A First Course in Probability; 10 th ed.; Pearson Education (2018)
8	Hines, William W.; Montgomery, Douglas C.; Goldsman, David M.; Borror, Connie M. Probability and Statistics in Engineering; 4 th ed.; John Wiley & Sons, Inc. (2003)
9	Boes, Duane C.; Graybill, Franklin A.; Mood, Alexander McFarlane. Introduction To the Theory of Statistics; 3 rd ed.; McGraw Hill Education (India) (2013)

Course Outcomes (Students will be able to.....)

CO1	understand the notion of differentiability and be able to find maxima and minima of functions of one and several variables.(K3)
CO2	compute surface and volume integrals.(K3)
CO3	understand the notion of vectors and vector spaces.(K2)
CO4	solve systems of linear equations and eigenvalue problems analytically and numerically.(K3)
CO5	fit relationship between two data sets using linear, non-linear regression.(K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	0	2	3	3	2	3	3	3	2	3	3
CO2	K3	3	3	2	2	2	3	1	1	3	3	2	1	3	3
CO3	K2	3	2	1	2	1	2	3	3	3	3	3	0	3	2
CO4	K3	3	3	2	1	2	3	2	0	0	0	3	2	3	3
CO5	K3	3	3	1	2	2	3	3	2	3	3	1	2	3	3
Course	K3	3	3	2	2	2	3	3	2	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

BSC	Course Code: PYT1205	Course Title: Applied Physics	Credits = 2		
	Semester: I	Total contact hours: 30	L	T	P
			2	0	0

Course Outcomes (students will be able to...)

1	Assign Miller indices to various crystallographic planes and directions in a crystal lattice, thereby understand periodicity in the crystal lattice.
2	Analyze a given x-ray diffraction pattern to deduce the crystal structure of the material and calculate the values of the basic structural parameters.
3	Classify solids, and in turn semiconductors, based on electron occupancy and calculate basic quantities related to charge transport in them.
4	Analyze simple ideal fluid flows by applying the continuity equation and Bernoulli's equation.
5	Describe the basic behaviour of viscous flows and the relationships between various flow parameters.
6	Understand simple models that are used to describe viscoelastic flows.

List of Prerequisite Courses

1	Standard XI and XII Physics course
2	Standard XII Chemistry course

List of Courses where this course will be prerequisite

1	Applied Physics Laboratory (Sem-II)
2	Materials Science Minor program courses (Sem-III, IV, V, VI, VII, VIII)
3	Open Elective courses from Physics Department (Sem-II, IV, V)

Description of relevance of this course in the B. Chem.Tech. Program

The physics of solids and fluids play a key role in the various areas of chemical technology. The Applied Physics course will provide the students with the necessary fundamentals to develop a broad understanding of various aspects related to solids and fluids, and thereby equip them with the ability to apply it wherever required in their course of study.

	Course Contents (Topics and subtopics)	Reqd. hours
<i>Solid State Physics</i>		
1	Crystal Structure of Solids: A revision of concepts of a lattice, a basis, unit cell, different crystal systems (SC, BCC, FCC, HCP), co-ordination number and packing fractions. Single crystalline, Polycrystalline, and Amorphous materials.	3
2	Crystallographic planes and directions: concept of Miller indices and its determination, examples; calculation of inter-planar spacing in terms of Miller indices.	3
3	Determination of crystal structure using X-rays: Bragg's law of X-ray diffraction, types of diffractometers, Indexing diffraction peaks and calculation of various lattice parameters and crystallite size	4
4	Energy band in solids and classification of solids, the concept of Fermi level and Fermi distribution function, Intrinsic and extrinsic semiconductors, Transport properties of semiconductors: Conductivity in semiconductors and its dependence of carrier concentration and mobility.	5
<i>Physics of Fluids</i>		
5	A revision of the basic concepts of hydrostatics and ideal fluid flow: Equation of continuity and Bernoulli's equation.	4
6	The concept of viscosity, Newton's law of viscosity, Reynold's number, Poiseuille's equation for streamline flows	4

6	An introduction to Rheology: Parameters of viscous flows, Newtonian and non-Newtonian behaviour, Variation of viscosity with shear rate, shear time, temperature, and pressure (qualitative ideas with illustrative examples), measuring properties of viscous flows. The concept of viscoelasticity, Maxwell and Kelvin models of relaxation, relaxation spectrum, creep testing.	7
Total		30
List of Textbooks/Reference books		
1	Fundamentals of Physics – Halliday, Resnick, Walker – 6 th Edition – John Wiley	
2	Sears and Zeemansky’s University Physics – Young and Freedman – 12 th Edition – Pearson Education	
3	A Textbook of Engineering Physics – M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy – 11 th Edition – S. Chand Publishers	
4	Solid State Physics – S. O. Pillai – 10 th Edition – New Age Publishers	
5	Solid State Physics – A. J. Dekker – MacMillan India	
6	Engineering Physics – V Rajendran – 6 th Edition – McGraw Hill Publishers	
7	Introduction to Rheology – H. A. Barnes, J. F. Hutton and K. Walters – 4 th Edition – Elsevier Science.	
8	Viscoelastic Properties of Polymers – J. D. Ferry – 3 rd Edition – Wiley	
Course Outcomes (Students will be able to.....)		
CO1	Apply acoustic cavitation of Chemical Engineering Processes. (K3)	
CO2	Apply Bernoulli equation in simple pipe flows. (K3)	
CO3	Introduced to the principles of lasers, types of lasers and applications. (K2)	
CO4	Calculate resolving power of instruments.(K3)	
CO5	Describe principles of optical fibre communication.(K2)	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	1	1	3	3	3	3	2	3	3
CO2	K3	3	1	2	1	2	3	3	3	3	3	0	2	1	3
CO3	K2	3	2	1	2	0	3	3	3	3	2	3	1	3	2
CO4	K3	2	3	2	1	2	2	0	2	3	3	3	2	0	3
CO5	K2	3	2	1	2	0	0	3	3	1	3	1	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

VSEC	Course Code: GET1305	Course Title: Engineering Graphics and Computer Aided Drawing	Credits = 3		
	Semester: I	Total Contact Hours: 75	L	T	P
List of Prerequisite Courses					
Mathematics, Geometry, basic drawing and visualization					
List of Courses where this course will be prerequisite					
Industrial drawing, Equipment Design, Manufacturing and designing of any component, industrial 3D product modelling etc.					
Description of relevance of this course in the B. Tech. Program					
Drawing is a language used by engineers and technologists. A student is required to know the various processes and the equipment used to carry out the processes. Some of the elementary areas like product sizing, manufacturing etc., are very common to all the branches of technology. These and many other processes require machines and equipment's. One should be familiar with the design, manufacturing, working, maintenance of such machines and equipments. The subject of "drawing" is a medium through which, one can learn all such matter, because the "drawings" are used to represent objects and various processes on the paper. Through the drawings, a lot of accurate information is conveyed which will not be practicable through a spoken word or a written text. This course is required in many subjects as well as later in the professional career.					
Course Contents (Topics and Subtopics)					Required Hours
1	Orthographic projections: Introduction, Principles of Projection, Methods of Projection, Planes of projection, Quadrants, First-angle method of projection, Third-angle method of projection, and concept of orthographic projections.				20
2	Sectional Projections and Missing Views: Need for the drawing sectional views, concept of sectioning and section lines, Sectional drawings of different solids and machine components, Auxiliary planes, and views. Missing Views: Concept of recognizing missing views and their interpretation, drawing of missing views from given orthographic drawings.				15
3	Isometric projections: Concept of isometric views, isometric projections and isometric scale, Iso metric projections of different solids and machine components				15
4	Computer Aided Drafting and Assembly drawing: Basic introduction to CAD softwares, Design and Development of new products, Application of CAD, 2D, 3D part modelling on softwares, drawing modification and dimensioning, modelling of different machine components. Basics of Assembly drawing, preparation of 2D, 3D components and assembling on CAD software, conversions, labelling and table creation for bill of materials.				25
Total					75
List of Textbooks/Reference Books					
1	Engineering Drawing by N.D.Bhat				
2	Engineering Drawing by N.H.Dubey				
3	CAD/CAM: Theory and Practice by Ibrahim Zeid and R Sivasubramanian				
Course Outcomes (Students will be able to.....)					
CO1	Draw Orthographic and Sectional Orthographic Views from Pictorial View 2 Draw isometric view when Front View and either top view or side view is given. 3 Understand basics of Assembly Drawing 4 Understand basics of CAD and Prepare 2D,3D drawings using CAD.				
CO2	Draw Orthographic and Sectional Orthographic Views from Pictorial View 2 Draw isometric view when Front View and either top view or side view is given. 3 Understand basics of Assembly Drawing 4 Understand basics of CAD and Prepare 2D,3D drawings using CAD.				
CO3	Draw Orthographic and Sectional Orthographic Views from Pictorial View 2 Draw isometric view when Front View and either top view or side view is given. 3 Understand basics of Assembly Drawing 4 Understand basics of CAD and Prepare 2D,3D drawings using CAD.				
CO4	Draw Orthographic and Sectional Orthographic Views from Pictorial View 2 Draw isometric view when Front View and either top view or side view is given. 3 Understand basics of Assembly Drawing 4 Understand basics of CAD and Prepare 2D,3D drawings using CAD.				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	3	3	3	1	2	3	2	3	1
CO3	K3	3	3	2	2	1	1	3	3	3	3	3	2	2	3
CO4	K3	3	3	2	2	2	3	0	2	3	3	3	2	3	1
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

ESC	Course Code: OLT 1101	Course Title: SPL1: Chemistry of Oils and Fatty Acids	Credits = 2		
	Semester: I		Total contact hours:30	L	T
			1	1	0
List of Prerequisite Courses					
HSC (Science), Organic Chemistry I, Organic Chemistry II					
List of Courses where this course will be prerequisite					
All the Oils, Oleochemicals& Surfactants Special Courses					
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals& Surfactants Technology) Programme					
Students will be able to understand the industrial chemistry of oils and fatty acids. They will be trained with respect to basics of sources of oils, minor constituents, physical and chemical properties of oils and fatty acids, various derivatisation pathways and related analytical tools.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1.	General introduction to oils, fats and waxes: Chemical structure, sources and composition. Classification of oils and fats by source type, fatty acid composition and drying properties. Statistics of Indian as well as world production of commercial oil seeds/ oil bearing materials, oils and fats, importance as feedstock for food and chemical industries.				3
2.	Physical characteristics of natural oils and fats: Oiliness and viscosity, density and expansibility, thermal properties, smoke, fire and flash points, solubility and miscibility, refractive index and molecular refraction, adsorption spectra, electrical properties, colour value.				4
3.	Fatty acids: Nomenclature and classification; saturated, monounsaturated, polyunsaturated fatty acid and essential fatty acids. Physical properties of fatty acids and their esters. Polymorphism and crystal structure, solubility, refractivity, optical activity, spectroscopic properties.				3
4.	Important minor/ non-triglyceride constituents of natural oils and fats: Phospholipids, galactolipids, sphingolipids, diacylglycerols, monoacylglycerols, sulfolipids, waxes, sterols, triterpene alcohols, and their esters, tocopherols/ tocotrienols, lipid-soluble vitamins, hydrocarbons, pigments, phenolic compounds etc.				4
5.	Separation and isolation of fatty acids: Distillation, crystallization and counter current distribution. Methods of structure determination.				2
6.	Hydrolysis and esterification: Acid-, base-catalyzed and enzymatic hydrolysis of oils/fats, Fat splitting process. Neutralization, saponification, formation of metallic soaps. Acylation, esterification, interesterification, transesterification.				4
7.	Chemical reactions of oils/fats and fatty acids: Estolide synthesis. Hydrogenation, halogenation, epoxidation, hydroxylation, ozonolysis, metathesis. Thermal and oxidative polymerization, Diels-Alder reaction, Stereomutation, double bond migration and cyclization.				10
Total					30
List of Text Books/ Reference Books					

1.	The Chemistry of Oils and Fats: Sources, Composition, Properties and Uses, Frank D. Gunstone, Blackwell Publishing Ltd, UK (2004).
2.	Fatty Acids in Industry, R. W. Johnson, and E. Fritz, eds., Marcel Dekker, Inc., New York, (1989).
3.	Bailey's Industrial Oil and Fat Products, Sixth Edition Vol. 1: Edible Oil and Fat Products: Chemistry, Properties, and Health Effects, Ed. Fereidoon Shahidi, John Wiley & Sons, Inc., Wiley Interscience Publication (2005).
4.	Oils and Fats Manual, Eds. A. Karleskind and J.-P. Wolff, Vols. I and II, Intercept Ltd., Andover, U.K. (1996).
5.	Fatty Acid and Lipid Chemistry, F. D. Gunstone, Blackie Academic and Professional, London, U.K. (1996).

Course Outcomes (Students will be able to.....)

CO1	Understand and explain the constitution of oils and fats and their importance as feedstock for food and chemical industries. (K2)
CO2	Analyze and illustrate the physical, chemical and stability characteristics of oils and fats/ fatty acids. (K4)
CO3	Understand the technical importance of the minor constituents of natural oils and fats.(K2)
CO4	Implement different modes of derivatizations of oils/ fatty acids. (K3)
CO5	Identify and interpret the tools for chemical analysis of oils and fats. (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO4	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

BSC	Course Code: PYP1101	Course Title: Physics Laboratory	Credits = 2		
	Semester: I	Total Contact Hours: 60	L	T	P
			0	0	4

List of Prerequisite Courses

Applied Physics

List of Courses where this course will be prerequisite

Independently set up, handle, and use basic setups to measure and obtain various physical quantities. Use basic instruments like vernier-caliper, screw-gauge, travelling microscope, thermometer, etc. to make accurate measurements. Correlate and use directly measured quantities to obtain the relevant parameters through appropriate formulae, calculations, and/or graphical plotting, thereby understand the measurement principle involved in the experimental setups. Preliminarily treat the obtained datasets statistically to obtain errors in the experiments.

Description of relevance of this course in the B. Tech. Program

The hands-on experience gained by the students in the Applied Physics laboratory course will equip them with basic experimental skills related to measurement of various important physical quantities. These skills will act as a useful foundation for other laboratory and theory courses in their area of specialization.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Determination of Co-efficient of Viscosity by Poiseuille's method	5
2	Thermistor characteristics: Determination of Bandgap of a semiconductor	6
3	Determination of compressibility of liquids using an Ultrasonic Interferometer	5
4	Measurement of thermal conductivity of a solid: Lee's disc method	6
5	Photoelectric effect: Determination of h/e	5
6	Hall effect: Determination of carrier type and concentration in a semiconductor	6
7	Newton's rings: Determination of wavelength of light	5
8	Laser Diffraction: Determination of particle size	8
9	Determination of Co-efficient of Viscosity by Poiseuille's method	8
10	Thermistor characteristics: Determination of Bandgap of a semiconductor	6
Total		60

List of Text Books/ Reference Books

1	Fundamentals of Physics - Halliday, Resnick, Walker - 6 th Edition - John Wiley
2	Sears and Zeemansky's University Physics - Young and Freedman - 12 th Edition - Pearson Education
3	A Textbook of Engineering Physics - M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy - 11 th Edition - S. Chand Publishers
4	Engineering Physics - V Rajendran - 6 th Edition - McGraw Hill Publishers
5	Concepts of Modern Physics - A. Beiser, McGraw-Hill.
6	Ultrasonics: Methods and Applications - J. Blitz, Butterworth.
7	Optics - Ajoy Ghatak - 7 th Edition - McGraw Hill
8	Fundamentals of Optics - F. Jenkins and H. White - 4 th Edition McGraw Hill
9	ICT Physics Laboratory Manual (supplied to students)

Course Outcomes (students will be able to.....)

CO1	Apply various laws which they have studied through experiments (K3)
CO2	Measure transport properties like viscosity, conductivity, etc.(K4)
CO3	Explain the application of acoustic cavitation (K2)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	1	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	3	2	3	3	2	3	3	3	0	2	3

CO3	K2	3	2	1	2	0	3	3	3	3	1	3	1	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

AEC	Course Code: HUT1110B	Course Title: Communication Skills-English	Credits = 2		
	Semester: I	Total Contact Hours: 60	L 0	T 0	P 4
List of Prerequisite Courses					
Standard XII th English					
List of Courses where this course will be prerequisite					
All courses in this and subsequent semesters					
Description of relevance of this course in the B. Tech. Program					
This is an important course for the effective functioning of an Engineer and a Technologist. Communication skills are required in all courses and professional career.					
Sr. No.	Course Contents (Topics and Subtopics)				Required Hours
1	Development of communication skills in oral as well as writing				10
2	The writing skills should emphasize technical report writing, scientific paper writing, letter drafting, etc.				14
3	The oral communication skills should emphasize presentation skills.				10
4	Use of audio-visual facilities like powerpoint, LCD. for making effective oral presentation				14
5	Group Discussions				12
Total				60	
List of Text Books/ Reference Books					
1	Elements of Style – Strunk and White				
Course Outcomes (students will be able to.....)					
CO1	write grammar error free technical reports in MS Word or equivalent software.(K3)				
CO2	make power point slides in MS PowerPoint or equivalent software.(K3)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	1	2	3	3
CO2	K3	3	3	2	0	2	3	1	3	3	2	3	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester-II

BSC	Course Code: CHT1407	Course Title: Organic Chemistry	Credits = 3		
	Semester: II		Total Contact Hours: 45	L	T
			2	1	0
List of Prerequisite Courses					
This is a Basic Organic Chemistry course. The Organic Chemistry studied at HSC is the basis for building up Advanced Organic Chemistry knowledge.					
List of Courses where this course will be Prerequisite					
Organic Chemistry, Biochemistry and several Special Subjects of Chemical Technology Departments					
Description of relevance of this course in the B. Tech. (Pharm. Chem. Tech.) Programme					
To acquaint the students with IUPAC and other types of Nomenclature of organic compounds, fundamentals of Organic Chemistry including reaction mechanisms, organic transformations, types of reactions, selectivity of chemical transformations, etc., stereochemical implications of organic reactions, functional group identification and reactions					
Sr. No.	Course Contents (Topics and Subtopics)				Required Hours
1	Chemistry of Carbonyl Compounds Concept of acidity and tautomerism of carbonyl compounds, General methods of preparation and Nucleophilic Addition reactions Enolate chemistry, Aldol and related condensation reactions, Michael reaction, Robinson annulation, Claisen condensation, Dieckmann condensation, Mannich reaction.				9
2	Aromatic Substitution Reactions A) Electrophilic Substitution Reactions Nitration, Halogenation, Alkylation, Acylation and Sulfonation Activating, deactivating and orienting effects of functional groups in mono- and poly-substituted benzenes Friedel-Crafts alkylation, Acylation, Gattermann, Gattermann-Koch, Riemer-Tiemann reactions. B) Nucleophilic Substitution Reactions Addition and elimination mechanism, Benzyne mechanism, Sandmeyer reaction.				10
3	Heteroaromatic Compounds IUPAC nomenclature, structures and common names, comparison with benzenoid compounds, reactivity and synthesis – pyrroles, furans, thiophenes and pyridines				8
5	Named Organic Reactions Perkin reaction (Mauvine synthesis-dyes), Fischer indole synthesis, (dyes), Jacobson Corey epoxide synthesis (Pharmaceutical), Ziegler Natta polymerisation (polymer), Multicomponent reactions, Mailard reaction (foods), Strecker amino acid synthesis (Pharmaceuticals & Food), Wittig reactions, Prilezhaev reaction				10
6	Stereochemistry of Organic Compounds Containing one and two asymmetric carbon atoms, Stereo descriptors – R/S, E/Z, erythro and thero, Conformation – Ethane and butane. Enantiomers and Diastereomers, meso compounds, different representations of stereoisomers – Saw-horse, Newmann, Wedge and dash and Fischer and their interconversions				8
Total					45
List of Text Books/Reference Books					
1	Clayden, J., Greeves, N., Warren, S.; Organic Chemistry; 2 nd ed.; Oxford University Press (2012)				
2	Graham Solomons, T. W.; Fryhle, Craig B.; Snyder, Scott A. Organic Chemistry; 12 th Ed.; John Wiley & Sons. Inc. (2016)				
3	Smith, M. B.; March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure; 7 th ed.; Wiley, India (2015)				
4	Carey F. A., Sundberg, R. J. Advanced Organic Chemistry: Part A: Structure and Mechanisms; 5 th ed.; Springer (2005)				

5	Carey F. A., Sundberg, R. J.; Advanced Organic Chemistry: Part B: Reaction and Synthesis; 5 th ed.; Springer (2007)
6	Wade, L. G.; Simek, J. W.; Singh, M. S. Organic Chemistry; 9 th ed.; Pearson Education (2019)
7	Eliel, E. L. Stereochemistry of Carbon Compounds; Mcgraw-Hill (2001)
8	Bruice, Paula, Y. Organic Chemistry; 8 th Ed.; Pearson Education (2020)

Course Outcomes (Students will be able to.....)	
CO1	Draw structures of organic compounds and write their IUPAC names correctly (K2).
CO2	be well versed with aromatic chemistry and interpret the outcome of general transformations (K3).
CO3	Understand the importance of heterocycles, learn the properties and synthetic routes, interpret the IUPAC of compounds and decipher outcomes of various transformations involving heterocycles (K3).
CO4	Apply the knowledge obtained through the course to predict the outcome of reactions and devise solutions to unknown problems (K3).
CO5	Appreciate the stereo-chemical implications of organic compounds and visualize and appreciate the chirality concept (K2).
CO6	Understand organic chemistry reactions related to aliphatic as well as aromatic compounds as well as decipher the outcome of a given organic transformation (K3).
CO7	Interpret and analyze reactions having different functionalities, deduce and solve problems related to the reactions as well as apply them, if need be (K4).

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	0	2	1	3	3	2	3	3	3	1	3	2
CO2	K2	3	2	0	1	0	3	3	1	2	3	2	0	3	2
CO3	K3	3	3	1	2	2	3	1	3	3	2	3	2	3	3
CO4	K4	3	3	1	3	2	3	2	3	2	3	3	2	3	3
CO5	K4	3	3	1	3	2	3	2	3	2	3	3	2	3	3
CO6	K4	3	3	1	3	2	3	2	3	2	3	3	2	3	3
CO7	K4	3	3	1	3	2	3	2	3	2	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
 K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

BSC	Course Code: CHT1408	Course Title: Industrial Chemistry	Credits = 3		
	Semester: II	Total Contact Hours: 45	L	T	P
			2	1	0
List of Prerequisite Courses					
Standard XII Inorganic Chemistry					
List of Courses where this course will be Prerequisite					
Material Technology, Environment Science and Technology					
Description of relevance of this course in the B. Tech. Programme					
To acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals					
Sr. No.	Course Contents (Topics and Subtopics)				Required Hours
1	Introduction to Chemical Industry: Bulk chemicals, fine chemicals, intermediates, active pharmaceutical ingredients (API), etc.				3
2	Petrochemical Industry: operations and processes in manufacture of ethers, hydrocarbons, aromatic compounds, etc.				6
3	PRIMARY INORGANIC MATERIALS: Water, Hydrogen, Hydrogen Peroxide and Inorganic Peroxo Compounds, Nitrogen and Nitrogen Compounds, Phosphorus and its Compounds, Sulfur and Sulfur Compounds, Halogens and Halogen Compounds,				8
4	MINERAL FERTILIZERS: Phosphorus-Containing Fertilizers, Nitrogen-Containing Fertilizers, Potassium-Containing Fertilizers				4
5	METALS AND THEIR COMPOUNDS: Alkali and Alkaline Earth Metals and their Compounds Aluminum and its Compounds, Chromium Compounds and Chromium, Silicon and its Inorganic Compounds, Manganese Compounds and Manganese				8
6	ORGANIC BULK CHEMICALS: Manufacture of methanol, acetic acid, ethanol, ethylene, propylene, butadiene, acetaldehyde, acetylene, BTX, alkyl benzenes, acetone, phenol, styrene, esters, ethylene oxide, phthalic acid, Vinyl-Halogen and Vinyl-Oxygen Compounds, azo dyes, Polyamides, Propene Conversion Products, Aromatics - Production and Oxidation Products of Xylene and Naphthalene				8
7	Important pharmaceutically active ingredients, agrochemicals, insecticides, pesticides, perfumery chemicals.				8
Total					45
List of Text Books/ Reference Books					
1	Industrial Organic Chemistry, 3rd, Completely Revised Edition, Klaus Weissermel, Hans-Jürgen Arpe ISBN: 978-3-527-61459-2 July 2008.				
2	Industrial Inorganic Chemistry, 2nd Completely Revised Edition, Karl Heinz Buchel, Hans-Heinrich Moretto, Dietmar Werner, ISBN: 978-3-527-61333-5, 667 pages, November 2008, Wiley-VCH.				
3	Inorganic Chemistry – an industrial and environmental perspective, T.W. Swaddle, ISBN 0-12- 678550-3 , 482 pages, Academic Press				
Course Outcomes (Students will be able to.....)					
CO1	Understand the important of chemical principles applied to various industrial processes				
CO2	Describe the fundamental processes underlying manufacture of important organic and inorganic chemicals				
CO3	Review and assess the impact of the chemical factors on the efficiency of industries and feedstock manufacturing				

CO4	Modify existing applications for improving the efficiencies in terms of yields, energy requirement and environmental impact
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Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	0	3	2	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	3	1	3	3	2	2	3	3
CO3	K2	3	2	0	2	1	3	3	3	3	0	3	1	2	1
CO4	K2	3	2	1	2	1	2	3	3	3	3	1	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

PCC	Course Code: OLT 1103	Course Title: SPL2:NUTRITION	Credits = 2		
	Semester: II	Total contact hours: 30	L	T	P
			1	1	0

List of Prerequisite Courses

HSC (Science), Biochemistry, Chemistry of oils

List of Courses where this course will be prerequisite

All the Oils, Oleochemicals& Surfactants Special Courses

Description of relevance of this course in the B. Tech. (Oils, Oleochemicals& Surfactants Technology) Programme

Students will be able to understand the lipids, basics of industrial chemistry of oils and Fatty Acids. They will be trained with respect to basics of sources of oils, minor constituents, physical and chemical properties of fatty acids, various derivatisation pathways and related analytical tools.

Sr No	Topics	No. of lectures
1	Introduction to Nutrition, Importance of study of Nutrition in health and disease, Branches of Nutrition, Nutrigenomics ,Neutraceuticals	2
2	Food as a source of nutrients, Sources and functions of Food, Concept of RDA of nutrients	1
3	Study of major food constituents viz Carbohydrates and Proteins with ref. to Chemical nature, classification, digestion, nutritional role and food sources	4
4	Study of Lipids with special ref. to classification of bio lipids, chemistry ,nomenclature of fatty acids, phospholipids, TG, sterols, digestion of fats, utilization and biosynthesis of Cholesterol and of fatty acids in plant and animal kingdom, sources and nutritional role of fats, essential fatty acids, transfats,CLAs ,lipoproteins, cholesterol	5
5	Proximate analysis of foods , Fuel value and Physiological fuel value of foods	1
6	Computation of daily calorie requirements with ref to BEE, AT and TEF, ICMR Calorie Requirements for Indians	2
7	Nondigestible carbohydrates, Dietary Fibre, Resistant starch, FOS, Pro and Prebiotics	3
8	Glycemic properties of carbohydrates ,fructose as a Health risk factor	1
9	Protein quality evaluation: Chemical score, PER, BV, NPU, PDCAA, Protein requirements at different life stages, Mutual supplementation, Available Lysine	2
10	Antinutritional factors in foods and their significance, Bioavailability of nutrients	2
11	Vitamins: Chemical nature, nutritional function, stability to processing conditions, deficiency symptoms, hypervitaminosis for fat soluble vitamins, RDAs and food sources	4
12	Minerals: nutritional role, RDAs, sources of macro and microelements	3

13	Role of nutrients in metabolic syndrome, CVD, Atherosclerosis, Diabetes, Hypertension, obesity	2
14	ABCDs of nutritional assessment	2
	Total	30

List of Text Books/ Reference Books

1	Lipid Biochemistry by Gurr,
2	Biochemistry by Lehninger
3	Nutrition by Young and Shil,
4	Food and Nutrition by Krauss

Course Outcomes (students will be able to.....)

CO 1	understand and explain the constitution of food and oils nutrition, Sources and functions of Food, Concept of RDA of nutrients and its importance (K2)
CO 2	Identify major food constituents like Carbohydrates, lipids and Proteins. (K3)
CO 3	Proximate analysis of foods, Computation of daily calorie requirements, Nondigestible carbohydrates, Dietary Fibre, Glycemic properties etc. (K4)
CO 4	Analyse protein quality, Antinutritional factors, vitamins and minerals etc. (K4)
CO 5	Ability to identify role of nutrients and ABCDs of nutritional assessment. (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

ESC	Course Code: GET1306	Course Title: Basic Mechanical Engineering	Credits = 2		
	Semester: II	Total Contact Hours: 30	L	T	P
			1	1	0
List of Prerequisite Courses					
Physics, Basic Mathematics					
List of Courses where this course will be Prerequisite					
Energy Engineering, Unit Operations, Mechanical design of chemical equipments					
Description of relevance of this course in the B. Tech. Programme					
Students will be able to understand various equipments like steam turbine, gas turbine, pumps, compressors, and power transmission system.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Introduction- Concept of Stress: Condition of Equilibrium for concurrent coplanar and non-concurrent coplanar forces. Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, Stress Strain Diagram, elastic constants and their relations volumetric, linear and shear strains.				6
2	Introduction to Thermodynamics: First Law of Thermodynamics, Steady-flow energy equation, Second Law of Thermodynamics				4
3	Basics of Power Station -Steam Generators Fire tube and Water tube boiler, Low pressure, and high-pressure boilers, Mountings and accessories, Boiler efficiency -Steam Turbines Working principle of steam, gas and water turbines, Concept of impulse and reaction steam turbines. -Compressors/Pumps Different Types of Compressors and their applications, Different Types of Pumps, and their applications				8
4	Transmission of Power: Introduction to various drives such as belt, rope, chain and gear drives, Introduction to mechanical elements such as keys, couplings, and bearings in power transmission (No numerical)				4
5	Refrigeration and Air-conditioning Vapour compression refrigeration cycle, Vapour absorption refrigeration systems, Properties of air such as DBT, WBT, DPT, relative humidity, Psychometric chart.				4
6	Renewable Energy Role and importance of non-conventional and alternate energy sources such as solar, wind, ocean, bio-mass and geothermal, hydrogen energy				4
Total					30
List of Text Books/ Reference Books					
1	Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd				
2	Thermodynamics by P.K. Nag				
3	Power plant by Morse				
4	Heat Engines by P.L. Balani				
5	Hydraulic Machines by Jagdish Lal				
6	Renewable Energy resources by Tiwari and ghosal, Narosa publication.				
7	Non-conventional energy sources, Khanna publications				
8	Refrigeration and air conditioning by C.P. Arora				
9	Theory of Machines by Rattan. S.S				
10	Gas turbine theory by HiH Saravanamuttoo				

Course Outcomes (Students will be able to.....)	
CO1	Understand different types of stresses and their effects on bodies. (K2)
CO2	Describe the working of steam boilers, mountings, and accessories. (K2)
CO3	Explain the working principles of power developing systems such as steam turbines, gas turbines and internal combustion engines. (K2)
CO4	Describe the working principle of vapour compression and vapour absorption refrigeration systems. (K2)
CO5	Discuss different types of power transmission systems and their typical applications. (K2)
CO6	Explain the working principles of power absorbing devices such as pumps and compressors. (K2)

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K2	3	1	0	2	1	3	1	3	3	3	3	1	3	2
CO3	K3	3	3	2	2	2	3	3	3	3	2	3	2	2	3
CO4	K2	3	2	1	2	0	3	3	2	3	3	3	1	3	2
CO5	K2	3	2	1	2	0	3	3	2	3	3	3	1	3	2
CO6	K2	3	2	1	2	0	3	3	2	3	3	3	1	3	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

ESC	Course Code: GET1125	Course Title: Electrical Engineering and Electronics	Credits = 2		
	Semester: II	Total Contact Hours: 30	L	T	P
			1	1	0
List of Prerequisite Courses					
Standard XII Physics and Mathematics courses					
List of Courses where this course will be prerequisite					
Various Technology Courses and Professional Career					
Description of relevance of this course in the B. Tech. Program					
In this course, Students will get an insight to the importance of Electrical Energy in Chemical Plants. The students will understand the basics of electricity, selection of different types of drives for a given application process. They will get basic knowledge as regards to Power supplies, instrumentation amplifiers and thyristor application in industries.					
Sr. No.	Course Contents (Topics and Subtopics)				Required Hours
1	Fundamentals of DC Circuits Voltage and Current Sources, Basic Laws, Network Theorems, Superposition Theorem and Thevenin's Theorem,				4
2	AC Fundamentals: A.C. through resistance, inductance and capacitance, simple RL, RC and RLC circuits. Power, power factor				4
3	Three Phase Systems: Three phase system of emfs and currents, Star and Delta connections, three phase power				5
4	Single phase transformers: Principle of working, Efficiency, regulation.				5
5	Electrical drives: Basic concepts of different types of Electrical motors as drives, Their suitability for various applications.				5
6	Regulated power supplies, Diodes as rectifiers, Half wave and Full wave rectifier, Filters and Regulators				5
7	Bipolar junction transistors: Different configurations, Characteristics, Concept of basic amplifier circuits, Amplifier gain, Transistor as switch				3
8	Introduction to Integrated circuits: Basic concepts of ICs				2
9	Introduction to data acquisition and signal conditioning, Basic concept and Block diagram, Concept of conversion of physical quantity to electrical signal, signal conditioning, Introduction to A/D and D/A converters				3
10	Introduction to instrumentation amplifiers and their applications Operational Amplifier – Notation, Pin diagram, Differential and common mode gain, CMRR, Introduction to various applications such as Non-inverting, inverting amplifiers, adder, subtractor, integrator, differentiator,				3
			Total		45
List of Textbooks/Reference Books					
1	Electrical Engineering Fundamentals by Vincent Deltoro				
2	Electronic devices and circuits by Boylestad, Nashelsky				
3	Electrical Machines by Nagrath, Kothari				
4	Electrical Technology by B.L. Theraja, A.K. Theraja vol I, II, IV				
Course Outcomes (Students will be able to.....)					
CO1	understand the basic concepts of D.C circuits. Solve basic electrical circuit problems.(K3)				
CO2	understand the basic concepts of single phase and three phase AC supply and circuits.(K2)				
CO3	understand the basic concepts of transformers and motors used as various industrial drives.(K2)				
CO4	understand the basic concepts of electronic devices and their applications.(K2)				

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K2	3	2	0	2	1	3	3	3	3	2	3	0	3	2
CO3	K2	3	2	1	2	0	3	3	2	3	3	3	1	3	2
CO4	K2	3	0	1	2	1	2	3	3	1	3	1	1	2	2
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

ESC	Course Code: CEP1720	Course Title: Process Calculations	Credits = 2		
			L	T	P
	Semester:	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
	XII th Standard Mathematics, Chemistry, Physics				
List of Courses where this course will be prerequisite					
	This is a basic Course. This knowledge will be required in ALL subjects later.				
Description of relevance of this course in the B. Tech. Program					
This is a basic course. This knowledge will be required in almost all subjects later. This subject introduces the various concepts used in Chemical Engineering to the students. The knowledge of this subject is required for in All B. Tech. courses, etc. It can be applied in various situations such as process selection, economics, sustainability, environmental impacts					
Sr. No.	Course Contents (Topics and subtopics)				Reqd. Hours
1	Introduction to Chemical process calculations, overview of single stage and multistage operations, concept of process flow sheets				2
2	Revision of Units and Dimensions, Dimensional analysis of equations, Mathematical techniques				4
3	Mole concept, composition relationship, types of flow rates				2
4	Material balance in non-reacting systems: application to single and multistage processes				8
5	Stoichiometry				2
6	Material balance in reacting systems: application to single and multistage processes				6
7	Behavior of gases and vapors				4
8	Introduction to psychrometry, humidity and air-conditioning calculations.				6
9	Calculation of X-Y diagrams based on Raoult's law.				2
10	Applications of material balances to Multiphase systems				6
11	Basic concepts of types of Energy and calculations				2
12	Application of Energy balance to non-reacting systems				6
13	Application of Energy balance to reacting systems				6
14	Fuels and combustion.				4
	Total				60
List of Text Books/ Reference Books					
	Elementary Principles of Chemical Processes, Felder, R.M. and Rousseau,				
	Chemical Process Principles, Hougen O.A., Watson K. M.				
	Basic Principles and Calculations in Chemical Engineering, Himmelblau,				
	Stoichiometry, Bhatt B.I. and Vora S.M.				
Course Outcomes (students will be able to.....)					
1	Students will be able to convert units of simple quantities from one set of units to another set of units				
2	Students will be able to calculate quantities and /or compositions, energy usages, etc. in various processes and process equipment such as reactors, filters, dryers, etc.				

Mapping of Course Outcomes (Cos) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K2	3	2	0	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	3	3	3	3	2	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

BSC	Course Code: CHP1343	Course Title: Physical and Analytical Chemistry Laboratory	Credits = 2		
	Semester: II	Total Contact Hours: 60	L	T	P
0 0 4					
List of Prerequisite Courses					
Standard XII th Chemistry Laboratory courses					
List of Courses where this course will be prerequisite					
This is a basic Course. This knowledge will be required in Applied Chemistry subjects later.					
Description of relevance of this course in the B. Tech. Program					
Students will become familiar with laboratory experimental skills, plan and interpretation of experimental tasks, understand the relevance of principles of physical chemistry in chemical processes					
Sr. No.	Course Contents (Topics and Subtopics)				Required Hours
1	(8 to 10 experiments will be conducted from following list) 1. To determine the total hardness of given water sample 2. To determine the dissociation constants of a polybasic acid using pH meter 3. To determine pKa of the given weak acid by potentiometric titration 4. To determine the critical micelle concentration (CMC) of the given surfactant by surface tension measurement using a stalagmometer 5. To determine the normality and volume of weak acid and strong acid in the given mixture using conductometric titration 6. To determine the rate constant of hydrolysis of an ester catalyzed by an acid 7. To study the kinetics of the reaction between K ₂ S ₂ O ₈ and KI and hence, determine rate of the reaction 8. To verify Beer – Lambert’s Law 9. To determine the equivalent conductance of strong electrolyte at infinite dilution and verify Ostwald’s law of dilution, for dissociation of weak electrolyte 10. To determine the molecular weight of the given polymer by viscosity measurements 11. To determine the vitamin C concentration from the given tablet sample by titration 12. Demo of Gas chromatography and FT-IR.				4h per practical
Total					60
List of Text Books/ Reference Books					
1	Practical physical Chemistry – B.Viswanthan and P.S. Raghavan				
2	Practical physical Chemistry- Alexander Findlay				
Course Outcomes (students will be able to.....)					
CO1	Identify reaction rate parameters				
CO2	List simple methods of chemical analysis				
CO3	Determination of physic chemical parameters using simple laboratory tools				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	2	3	3	2	3	3
CO2	K4	3	3	1	3	1	2	3	1	3	3	0	2	3	3
CO2	K4	3	3	1	3	1	2	3	1	3	3	0	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
 K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

VSEC	Course Code: CHP1132	Course Title: Organic Chemistry Laboratory	Credits = 2		
	Semester: II		Total Contact Hours: 60	L	T
			0	0	4
List of Prerequisite Courses					
Standard XII th Organic Chemistry Laboratory					
List of Courses where this course will be prerequisite					
All the Applied Chemistry Practicals					
Description of relevance of this course in the B. Tech. Program					
The course is relevant for training the students for working with binary mixtures. The students are exposed to basics of organic separations and identification of organic compounds based on their physicochemical properties. The laboratory training is crucial for the students to carry out work-up of organic reactions leading to separation of crude products followed by purification using recrystallization and/or distillation or related methods.					
	Course Contents (Topics and Subtopics)				Required Hours
1	a) Principles of qualitative separation of organic mixtures using physical properties, chemical properties and their combination				4
	b) Principles of quantitative separation of organic mixtures using physical properties, chemical properties and their combination				4
2	a) Separation of solid-solid water insoluble binary organic mixtures				5X4
	b) Separation of solid-solid partly water soluble binary organic mixtures				2X4
	c) Separation of solid-solid mixtures by fractional crystallization				2X4
	d) Separation of liquid-liquid mixtures by distillation				2X4
	e) Separation of liquid-liquid mixtures by solvent extraction				2X4
	Total				60
List of Textbooks/Reference Books					
1	Arthur, Vogel. Textbook of Practical Organic Chemistry, 5 th edition, publishers Longman group Ltd, 1989				
2	F.G. Mann and B.C. Saunders, Practical Organic Chemistry, 4 th edition published by Orient Longman				
3	Keese, R, Martin P. B, and Trevor P. Toubé. Practical Organic Synthesis: A Student's Guide. John Wiley & Sons, 2006.				
Course Outcomes (Students will be able to.....)					
CO1	work safely in the organic chemistry laboratory.(K3)				
CO2	separate binary organic mixtures by multiple techniques.(K4)				
CO3	understand basic principles for separation of binary organic mixtures qualitatively and quantitatively.(K3)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	0	3	3
CO2	K4	3	3	2	3	2	3	3	0	3	3	3	2	2	3
CO3	K3	3	1	2	1	2	2	3	3	3	3	1	2	3	1
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester-III

PCC	Course Code: OLT 1102	Course Title: SPL3:Chemistry of Oleochemicals and Surfactants	Credits = 4		
	Semester: III	Total contact hours: 60	L	T	P
			3	1	0
List of Prerequisite Courses					
HSC (Science)					
List of Courses where this course will be prerequisite					
All the Oils, Oleochemicals& Surfactants Special Courses					
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals& Surfactants Technology) Programme					
Students will be able to understand the industrial chemistry of Surfactants and Oleochemicals. They will be trained with respect to techniques of synthesis of oleochemicals and surfactants, colloidal behavior, interfacial phenomenon, and related analytical tools.					
Sr. No.	Course Contents (Topics and subtopics)				Teaching Hours
1.	Oleochemical and Surfactant raw materials and their derivatives as feedstock for Chemical Industries, Worldwide Statistics of Oleochemical and Surfactant Industries				08
2.	Different techniques of synthesis of Fatty Acid Methyl Esters (FAME), Glycerol and Fatty Alcohols, Fatty Amines, Amides, and Nitriles and their physical and chemical characteristics				08
3.	Introduction to the nature of colloidal solutions, Surface Tension and Energy, Definition and classification of surfactants, Hydrophilic and hydrophobic groups and HLB balance, Theory of Surface Actions.				06
4.	Self-assembly and packing features of surfactants (bi and multilayers, direct & reverse micelles, vesicles, Microemulsions). Thermodynamics of Adsorption and Micellization, structure of micelles				06
5.	Different surface activity phenomenon: Emulsification & de-emulsification, foaming & defoaming, Solubilisation, Dispersion, Wetting, Detergency Prediction of emulsion type from packing geometry, general phase behaviour and Solubility–Temperature Relationship for Surfactants, phase inversion, Kraft and Cloud point				06
6.	Synthesis, analysis and applications of Anionic surfactants: Sulphonates (FAMES , AOS, LABS , Paraffin S., Ester & Amide S.), Sulphates (Alcohol & Alcohol ether sulphates, TRO , Sulphated MG, Sulphated Alkanolamides), N-acylated amino acids, Alkyl Phosphates, Sulphosuccinates etc.				10
7.	Synthesis, analysis and applications of Nonionic Surfactants: Fatty Alcohol ethers, Alcohol Polyglycol Ethers, Alkyl phenol ethers, Mono and diglycerides, Lecithin, Polyol esters (TWIN, SPAN, Sucrose polyester), Alkanolamides etc. Polymeric and Gemini Surfactants				08
8.	Synthesis, analysis and applications of Cationic and Amphoteric Surfactants: Alkoxylated amines, Amine oxide, 2-Alkyl imidazoline, N-alkyl-β-Alanine, Quaternary Ammonium Compounds, Betains, Sulphobetains etc. Speciality Fluorocarbon and Silicone Surfactants				08
	Total				60

List of Text Books/ Reference Books

1.	Synthetic Detergents, Davidson, A. S.; Milwidsky, B. 7 th Ed. John Wiley and Sons, New York, (1987).
2.	<u>Handbook of Surfactants</u> , Porter, M. R., Springer Science and Business Media (1993).
3.	<u>Surfactants in Consumer Products: Theory, Technology and Applications</u> , Ed. J. Falbe, Springer-Verlag, Berlin (1987).
4.	<u>Industrial Applications of Surfactants-II</u> , D. R. Karsa, Royal society of Chemistry (1990).
5	Bailey's Industrial Oil and Fat Products, D. Swern, ed., Vol. I (1979), Vol. 2 (1982), 4 th ed., John Wiley & Sons, Inc., New York,.
6	Bailey's Industrial Oil and Fat Products, Sixth Edition Vol. 6: Industrial and Nonedible Products from Oils and Fats, Ed. FereidoonShahidi, Wiley Interscience Publication (2005).
7	Fatty Acids in Industry, R. W. Johnson, and E. Fritz, eds., Marcel Dekker, Inc., New York, (1989).
8	Richard M.; Marilyn E. K.; Pashley. Applied Colloid and Surface Chemistry, <i>John Wiley and Sons Ltd</i> , Chichester, UK (2004).
9	Richard M.; Marilyn E. K.; Pashley. Applied Colloid and Surface Chemistry, <i>John Wiley and Sons Ltd</i> , Chichester, UK (2004).

Course Outcomes (Students will be able to.....)

CO1	Understand the technical significance of Oleochemical and Surfactant Industries. (K2).
CO2	Conceptualize and develop the different modes of derivatizations of oleochemical and surfactants and its applications (K6).
CO3	Analyse and illustrate the HLB, diverse interfacial phenomenon, molecular aggregations and phase behaviour of surfactants.(K4)
CO6	Ability to identify and interpret the role of surfactants as specialty and high performance chemicals. (K5)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO4	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	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

PCC	Course Code: OLT 1104	Course Title: SPL-4:Chemistry of Essential Oils and their Applications	Credits = 2		
			L	T	P
	Semester: III	Total Contact Hours: 30	1	1	0
List of Prerequisite Courses					
Chemistry of Oils and fatty acids (OLT 1101)					
List of Courses where this course will be Prerequisite					
Technology of Oleochemicals (OLT 1112), Cosmetics Science (OLT 1107)					
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry behind the oils, lipids, essential oils. They will be able to explain its applications in various fields according to the chemistry involved.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Advanced methods of analysis of oils: Chromatography of oils, fats and derivatives. Packed column gas chromatography. Thin layer Chromatography, Ultra Violet spectroscopy, Infra Red Spectroscopy				8
2	Gas Liquid Chromatography. High performance liquid chromatography, Mass spectrometry of triglycerides and related compounds. Nuclear Magnetic Resonance Spectroscopy.				5
3	Essential oils: extraction from different sources, separation and purification. Enflurage, Maceration, solvent extraction, supercritical extraction, water distillation, water steam distillation and steam distillation. Analysis of essential oils for RI, optical rotation, density, solubility, boiling point, melting point.				7
4	Characteristics and composition of Indian essential oils like sandal wood oil, pine oil, cedar wood oil, palmrosa oil, patchouli, mint, clove, cardamom, cinnamon leaf oils, coriendor oil, ajwan, cumene, vetivert, eucalyptus, rosha oil, citrus oils, orange oils, rose, jasmine juichameli oils etc. Role of essential oil in aroma therapy. Stability studies of essential oil. Evaluation and testing of essential oils by sensory hedonic and substantively and GC tests.				10
Total					30
List of Text Books/ Reference Books					
1	Essential oils (Vol. I to VI) by Guenther E.				
2	Perfume and flavour materials of natural origin by Arctander S.				
3	Perfume, Cosmetics and Soap by Poucher W., Chapman and Hall Ltd., (1959)				
4	Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)				
12	Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)				
Course Outcomes (Students will be able to.....)					
CO1	Able to understand the basic process of glyceride synthesis, optically active glycerides and allied products. (K2)				
CO2	Selects the process for the manufacture of monoglyceride, diglycerides, and isomers. (K4)				
CO3	Select or identify advance method of analysis of oils and lipids like GC, MS, HPLC, NMR (K4)				
CO4	Discuss novel process of extraction of essential oils from various natural sources and different types of Essential Oils. (K5)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO4	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	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

EEM	Course Code: HUT1205	Course Title:	Credits = 2		
		Basic Economics and Finance	L	T	P
	Semester: III	Total Contact Hours: 30	2	0	0
List of Prerequisite Courses					
Course Outcomes (students will be able to.....)					
1	Students will be able to know and apply accounting and finance theory.				
2	Students will be able to understand the mechanics of preparation of financial statements, their analysis and interpretation				
3	Students will be able to explain basic economic terms, concepts, and theories				
4	Students will be able to identify key macroeconomic indicators				
List of Prerequisite Courses					
	MATHS-1 AND MATHS -2 OF FIRST YEAR COURSEWORK				
List of Courses where this course will be prerequisite					
	PROJECT ECONOMICS				
	FUNDAMENTALS OF MARKETING MANAGEMENT AND MARKET RESEARCH				
Description of relevance of this course in the BACHELOR'S Program					
	Course Contents (Topics and subtopics)	Reqd. hours			
1	INTRODUCTION Explaining the Economy The Supply and Demand Model Using the Supply and Demand Model	3			
2	THE COMPETITIVE EQUILIBRIUM MODEL Deriving Demand Deriving Supply Market Equilibrium and Efficiency	5			
3	DEVIATIONS FROM COMPETITION Monopoly and Market Power Between Monopoly and Competition	5			

	Antitrust Policy and Regulation	
4	MACRO FACTS AND MEASURES Getting Started with Macroeconomic Ideas Measuring Production, Income and Spending of Nations	5
5	ACCOUNTING TRANSACTIONS Journal entries Debit credit rules Compound journal entry Journal and ledger Rules of posting entries Trial balance	5
6	CAPITAL AND REVENUE Income and expenditure Expired costs and income Final accounts Manufacturing accounts Trading accounts Profit and Loss account Suspense account Balance sheet	5
7	CONCEPT OF DEPRECIATION	2
List of Textbooks		
	Finance and Accounting for Nonfinancial Managers: All the Basics You Need to Know -William G. Droms and Jay O. Wright Microeconomics: Basic Principles and Applications- A A Temu, D W Ndyetabula, et al PRINCIPLES OF ECONOMICS(12e)- E. Case Karl, C. Fair Ray, et al	
List of Additional Reading Material / Reference Books		
	Basic Finance for Nonfinancial Managers: A Guide to Finance and Accounting Principles for Nonfinancial Managers- Kendrick Fernandez Microeconomic Theory: Basic Principles and Extensions- Walter Nicholson and Christopher Snyder Macroeconomics(10e) Part of: Pearson Series in Economics (23 books) - by Froyen	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	3	3	3	1	2	3	2	3	1
CO3	K3	3	3	2	2	1	1	3	3	3	3	3	2	2	3
CO4	K3	3	3	2	2	2	3	0	2	3	3	3	2	3	1
CO5	K3	3	2	2	0	2	3	3	3	1	3	0	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

PCC	Course Code: OLP 1201	Course Title: Pr 1: Analysis of Oilseeds, Oils and Raw Materials of Oils and Soap Industry	Credits = 2		
	Semester: III	Total contact hours: 60	L	T	P
			0	0	4

List of Prerequisite Courses

H. Sc. (Science) and Chemistry of Oils

List of Courses where this course will be prerequisite

All the Oils, Oleochemicals & Surfactants Special Courses

Description of relevance of this course in the B. Tech. (Oils) Program

Student will understand basic analysis of the oilseeds, oils, fats, soaps etc.

	Course contents(topics/subtopics)	Required hrs
1	Standardization of Na ₂ S ₂ O ₃ , NaOH and HCl, Determination, Analysis of NaOH, Analysis of acetic acid	3
2	Determine Volatile content by air, oven method, Determine specific gravity of oil and glycerine, the viscosity of given sample by using viscometer	3
3	amine content in given sample by indicator method	5
4	Determination of titer value of given fatty acid	5
5	Determination of aldehyde content in the given oil sample	5
6	determine the hardness of water in PPM by complexometric titration with EDTA	3
7	To determine the acid value of heptanal	4
8	To determine the crystallization and supercooling of a given sample	3
9	Determine oxirane oxygen value in given oil sample	2
10	To determine the refractive index and color by Lovibond Tintometer of the given oil sample	3
11	To detect castor oil and soyabean oil mixture in TLC	2
12	Analysis of materials used in oils, fats and soap industry. Water, acids and industrial solvents	3
13	Analysis of Oils and Fats: Determination of physical and chemical characteristics of oils, fats, Vanaspati, margarine, ghee and waxes	3
14	Analysis of seeds, cakes and extractions	3
15	Detection of oils in mixtures	1
16	auto-oxidation and rancidity (estimation)	3
17	Analysis of mixture of fatty acids. Titre. GLC analysis. R.M., P and K values determination for butter and coconut oil	2
18	Analysis of crude and pure glycerine	3
19	Analysis of commercial fatty acids, including GLC	2
20	Analysis of monoglycerides, oleochemicals and oil derivatives of unsaponification matter in oil sample	2
	Total	60

List of Text Books/ Reference Books

1	Industrial Oils and Fats by A. E. Bailey
2	Fatty Acids by Robert Johnson

3	Fats and Oils Handbook by Bockisch Michael
Course Outcomes (students will be able to.....)	
1	Analyze and evaluate physical characteristics of oils like specific gravity, refractive index, color, viscosity etc. (K4)
2	Evaluate properties of oils, fatty acids and oleochemicals like acid value, sap value, iodine value, oxidation, crystallization, oxirane value, amine value etc. (K5)
3	Analysis of seeds, cakes and extractions, Detection of oils in mixtures, Vanaspati, margarine, ghee and waxes (K4)
4	Analyze hardness of water in PPM by complexometric titration with EDTA (K4)
5	Analysis by Advance analytical technique (GLC analysis) and separation of mixtures of oils by TLC (K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K4	3	3	2	3	2	3	3	3	2	3	2	2	3	3
CO2	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K4	3	3	2	3	2	3	3	3	2	3	2	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	2	3	2	2	3	3
CO5	K4	3	3	2	3	2	3	3	3	2	3	2	2	3	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	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

PCC	Course Code: OLP 1213	Course Title: Pr. 2: Preparation and Purification of Organic Derivatives	Credits = 2		
	Semester: III	Total contact hours: 60	L 0	T 0	P 4
List of Prerequisite Courses					
HSC (Science), Organic Chemistry Laboratory (Semester I/II)					
List of Courses where this course will be prerequisite					
Chemistry of Oleochemicals and Surfactants, Production and Applications of Soaps, Surfactants and Detergents					
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme					
Students will be able to learn and execute various derivatization techniques of organic functional groups. They will be trained to isolate solid crude products and purify those via crystallization. They will also learn to calculate yield of reaction. Finally, the students will learn thin layer chromatography (TLC) techniques and calculate R_f values.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1.	Thin layer chromatography (TLC): I. Techniques to perform thin layer chromatography (TLC) (essential for monitoring progress of a reaction). Calculation of R_f values in different solvent systems. II. Separation of mixture of organic compounds by TLC - Mixtures of two different unknown organic compounds will be provided. The R_f values for each of the compounds in the mixture is to be reported.				20
2.	Preparation of important organic compounds and their purification: Different types of organic reactions will be performed. The crude product will be isolated and purified via recrystallization process. Isolated yield of the product is to be reported. Melting point of the purified product is to be noted. The following organic preparations are to be carried out (any five): I. Preparation of acetanilide from aniline (acetylation of primary aromatic amines) II. Preparation of <i>para</i> -acetylaminophenol (paracetamol) from 4-aminophenol (acetylation of primary amines in presence of hydroxyl group) III. Preparation of acetyl salicylic acid (aspirin) from salicylic acid and acetic anhydride (acetylation of phenols) IV. Preparation of dibenzylideneacetone (dibenzalacetone) from acetone and benzaldehyde (aldol condensation) V. Preparation of <i>para</i> -bromoacetanilide from acetanilide (bromination of aromatic ring) VI. Preparation of Diels-Alder adduct between furan and maleic acid ([4+2] cycloaddition reaction) VII. Preparation of dihydropyrimidinone (three-component coupling reaction) VIII. Preparation of <i>para</i> -toluic acid from <i>para</i> -tolunitrile (hydrolysis of nitrile)				40
Total					60
List of Text Books/ Reference Books					
1.	Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).				

2.	Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
3.	Green Chemistry Task Force Committee, DST (Brindaban C. Ranu, Co-ordinator). Monograph on Green Chemistry Laboratory Experiments.
Course Outcomes (Students will be able to.....)	
CO1	Execute various derivatization techniques to synthesize important organic compounds. (K3)
CO2	Analyze purity of solid organic compounds via melting point determination. (K4)
CO3	Learn and apply thin layer chromatography (TLC) techniques to calculate R _f values of unknown compounds. (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	3	3	3
CO2	K4	3	3	2	3	2	3	3	3	2	3	2	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	2	3	2	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

Semester-IV

PCC	Course Code: CET1105	Course Title: Transport Phenomena	Credits = 4		
	Semester: IV	Total Contact Hours: 60	L	T	P
			3	1	0

List of Prerequisite Courses

XIIth Standard Physics and Mathematics

List of Courses where this course will be prerequisite

This is a basic course required in special subjects that deal with flow offluids, heat and mass transfer, etc.

Description of relevance of this course in the B. Tech. Program

This basic course introduces concepts of momentum, heat and mass transfer to students. Various other concepts such as pressure, momentum, energy are introduced as well. Laws related to conservation of momentum, energy, mass are taught. Applications of these laws to various engineering and technological situations and process equipments are explained with the help of several problems.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Fluid Statics and applications to engineering importance.	4
2	Applications of Bernoulli's Equation, Pressure drop in pipes and Fittings, meters, and fluid moving machinery such as pumps.	10
3	Particle Dynamics, Flow through Fixed and Fluidised Beds	4
4	Equations of Continuity and Motion in laminar flows and its applications for simple Couette flow and Poiseuille flow applications	6
5	Heat conduction. Convective heat transfer and concept of heat transfer coefficient.	4
6	Design and constructional aspects of exchangers: Types of flows: Concurrent, counter-current and cross flows, log mean temperature difference, double pipe and Shell and tube heat exchangers. Introduction to other heat exchangers like, PHE, finned tube heat exchangers, graphite block, etc.	10
7	Heat transfer aspects in agitated tanks, condensers, reboilers and evaporators.	6
8	Fundamentals of mass transfer: Molecular diffusion in fluids, concept of mass transfer coefficients, and interface mass transfer.	4
9	Theories of Mass transfer, Analogies for heat and mass transfer, Empirical correlations	4
10	Mass transfer applications in simple 1-D situations.	8
	Total	60

List of Text Books/ Reference Books

1	Transport Phenomena, Bird R.B., Stewart W.E., Lightfoot E.N.
2	Fluid Mechanics, Kundu Pijush K.
3	Fluid Mechanics, F. W. White
4	Unit Operations of Chemical Engineering, McCabe, Smith

Course Outcomes (students will be able to.....)

CO1	Students should be able to calculate friction factor, pressure drop, power requirements of single phase flow in a circular pipe
CO2	Students will be able to calculate flow and power required for pumps
CO3	Students should be able to calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers
CO4	Students should be able to calculate mass transfer coefficients and estimate mass transfer rates in simple situations

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	1	2	1	3	1	3	3	3	1	2	3	3
CO3	K3	3	1	2	2	2	2	3	2	3	3	3	2	2	3
CO4	K3	3	3	2	0	2	3	3	3	3	2	3	0	3	3

Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
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3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

PCC	Course Code: OLT 1111	Course Title: SPL5: Nutraceuticals	Credits = 3		
	Semester: IV	Total contact hours: 45	L 2	T 1	P 0
List of Prerequisite Courses					
Chemistry of Oils and fatty acids, chemistry of oils, lipids and Essential Oils					
List of Courses where this course will be prerequisite					
Advanced nutrition					
Description of relevance of this course in the B. Tech. (oil) Programme					
Students will understand the micronutrients in oils and fats and will be able to explain methods of separation and applications of it.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction to nutraceuticals: definitions, synonymous terms, claims for a compound as nutraceutical, regulatory issues.				10
2	Study of Properties, structure and functions of various Nutraceuticals, such as carotene, lycopene, omega fatty acids, phytosterolsetc, formulation of functional food, stability, analysis.				15
3	Manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids.				10
4	Food as remedies, Anti-nutritional Factors present in Foods, Nutritional Genomics Nutraceutical Industry and Market Information, Nutraceuticals and the Future of Medical Science and Consumers'views on nutraceuticals, Labeling and claims for Nutraceuticals products				10
	Total				45
Course Outcomes (students will be					
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 and claims for Nutraceuticals products of perfumery chemicals (K4)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

CO5	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	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

PCC	Course Code: OLT 1118	Course Title: SPL6:Technology of Perfumery Chemicals	Credits = 3		
			L	T	P
	Semester: IV	Total contact hours: 45	2	1	0

List of Prerequisite Courses

Chemistry of Oils and Essential Oils

List of Courses where this course will be Prerequisite

Processing of Soaps, Surfactants and Detergents and Triboapplications laboratory

Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme

To acquaint the students with natural, nature identical and synthetic perfumery chemicals; structure, synthesis and applications of fragrance chemicals.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Study of reactions like hydrogenation, oxidation, reduction, epoxidation, hydrolysis, esterification, aldol condensation for perfumery chemicals etc.	10
2	Chemistry of terpenes and terpenoids. Preparation of terpeneless and sesquiterpenless oils. Technology of preparation for alcohols, esters, aldehydes, ketones.	10
3	Biosynthesis of monoterpenoids. Synthetic geraniol, geraniol esters, synthesis of terpene alcohols and their esters. Citronellol and their esters. Alpha terpineol: chemical synthesis.	5
4	Terpenyl acetate and other esters. Linalool, nerol, menthol: chemical synthesis and their esters. Synthesis of vanillin, heliotropin, terpene ketone, ionones, methyl ionones, jasmon, benzyl acetate, acetophenone, terpene aldehydes, citral.	10
5	Tutorials	10
Total		10

List of Text Books/ Reference Books

1	Common Fragrance and Flavor Materials by Horst Surburg and Johannes Panten. 5 th Ed. WILEY-VCH, 2006.
2	Flavours and Fragrances (Chemistry, Bioprocessing and Sustainability) by Ralf Günter Berger.
3	Flavours and Fragrances (Chapter 3, Page: 45-168); Natural Products in the Chemical Industry by Schaefer, B. Springer, 2014.

Course Outcomes (Students will be able to.....)

CO1	Understand the fundamental knowledge on perfumery chemicals (K2)
CO2	Distinguish between terpenoids and non-terpenoids perfumery chemicals (K4)
CO3	Apply the fundamental reactions for the synthesis of various aroma chemicals (K3)
CO4	Apply the knowledge gained on various perfumery chemicals to the blending applications (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K3	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

EEM	Course Code: CET1805	Course Title: Chemical Process Economics	Credits=2		
	Semester: IV		Total contact hours: 30	L	T
			2	0	0
List of Prerequisite Courses					
	Material and Energy Balance Calculations, Equip Design and Drawing I, Energy Engineering, Ind Eng Chem.				
List of Courses where this course will be prerequisite					
	Home Paper I and II				
Description of relevance of this course in the B Tech.Program					
This course is required for the future professional career					
	Course Contents (Topics and subtopics)				Reqd.
2					5
4					5
5					5
6					2
7					5
9					4
	Total				30
List of Text Books/ Reference Books					
1	Chemical Project Economics, Mahajani V.V. and Mokashi SM.				
2	Plant Design and Economics for Chemical Engineers, Peters M.S., Timmerhaus K.D.				
3	Process Plant and Equipment Cost Estimation, Kharbanda O.P.				
Course Outcomes (students will be able to.....)					
1	Calculate working capital requirement for a given project				
2	Calculate cost of equipment used in a plant total project cost				
3	Calculate cashflow from a given project				
4	Select a site for the project from given alternatives				
5	List out various mile stones related to project concept to commissioning				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	2	2	2	3	3	3	3	3	2	2	2	3
CO3	K3	3	3	1	0	2	3	1	3	3	3	3	2	3	2
CO4	K4	3	3	2	3	2	2	3	3	3	3	3	2	3	3
CO5	K2	3	2	1	2	1	3	3	3	3	0	3	1	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
 K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: HUT1206	Course Title: Environmental Sciences	Credits = 2		
			L	T	P
	Semester: III	Total contact hours: 30	2	0	0
Course Outcomes (students will be able to.....)					
1	Describe the methods of industrial effluent treatment				
2	apply the learning for selection and implementation of appropriate waste management technique for sustainable development				
List of Prerequisite Courses					
Course Contents (Topics and subtopics)					Reqd. hours
1	(a) Concept of circular economy, EHS management (b) Environment management systems in the chemical industry (c) Legal provisions for environmental management: EP Act 1986; Air Act, 1981; Water Act, 1974; Hazardous waste management Rules, 2019				6
2	Importance of ecology, effluent treatment and discharging norms for treated water				6
3	SPCB consent parameters, monitoring and analysis				4
4	External monitoring of ambient air, noise, stacks, etc				4
5	Air pollutants, sources and effects on human health and environment, monitoring and analysis				6
6	Life cycle analysis, environmental impact assessment				4
List of Text Books					
1	Introduction to Environmental Engineering and Science by Gilbert M Masters and Wendell P Ela				
2	Environmental Pollution Control Engineering, C. S. Rao				
3	Principles of Instrumental Analysis by D. A. Skoog, F. James Holler and S. R. Crouch, Cengage Learning, 2007				
List of Additional Reading Material / Reference Books					

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	2	3	3	2	3	3	3	2	3	3
CO2	K3	3	3	2	2	0	3	3	3	3	3	3	1	3	3
CO3	K3	3	3	0	2	2	3	1	3	3	1	3	2	2	3
CO4	K3	3	1	2	2	2	3	3	3	3	3	0	2	3	3
CO5	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

VSEC	Course Code: OLP 1203	Course Title: Pr3: Analysis of Surfactants	Credits = 2		
			L	T	P
	Semester: IV	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
Chemistry of Surfactants					
List of Courses where this course will be prerequisite					
Cosmetics Science Technology of Oleochemicals					
Description of relevance of this course in the B. Tech. Programme					
Students will understand the various analytical and chemical/ wet analysis of surfactants					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Analysis of basic ingredient of surfactants: LABS, soap, non-ionic, LAS, alkylsulphate etc. Analysis of detergents for active matter, water/alcohol insolubles, free alkalinity				9
2	Qualitative analysis of types of surfactants: analysis of types – pinacryptol yellow/ anionic, cationic, nonionic, amphoterric surfactants				10
3	Elemental analysis and class of surfactants: carboxylates, sulfates, sulfonates, types of hydrophobes in these anionics specifically sulfates, sulfonats, Spot tests for various functional groups				8
4	Cationics: quarternary ammonium compounds, amine salts, characterization of amines				5
5	Nonionics: glycerol esters, ethylene oxide, propylene oxide, simple tests of SV, AV, OHV, for nonionics like fatty alcohols (see also quantitative)				6
6	Quantitative analysis: for anionics and cationics, preparation of various, reagents and standardization of these, quantitative separation using column chromatography. Quantitative tests: amine value, acid value, sap value				8
7	Physicochemical evaluation: surface tension, interfacial tension, determination of CMC using these and also using dye methods, emulsification tests, determination of HLB of surfactants, lime soap dispersion tests, foaming using Ross/ Mils tests.				9
8	Detergency tests: standard soiling and tergotometer, instrumental methods of analysis.				5
	Analysis of Detergents including: DC, a-alkylate, active, anionic, block copolymers				60
List of Text Books/ Reference Books					
1	Handbook of Surfactants, Porter, M. R., Springer Science and Business Media (1993).				
2	Surfactants in Consumer Products: Theory, Technology and Applications, Ed. J. Falbe, Springer-Verlag, Berlin (1987).				
3	Industrial Applications of Surfactants-II, D. R. Karsa, Royal society of Chemistry (1990).				
Course Outcomes (students will be able to					
1	understand basic analytical techniques for surfactants (K2)				
2	Perform wet analytical techniques and elemental analysis for surfactants K4				
3	Evaluate physical properties of surfactants (K5)				
4	Evaluate separation techniques for surfactants (K5)				
5	Able to explain the analysis of detergents (K4)				

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	2	3	2	3	3
CO3	K5	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	K5	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO5	K4	3	3	2	3	2	3	3	3	3	2	3	2	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

Semester-V

PCC	Course Code: CET1806	Course Title: Chemical Reaction Engineering	Credits = 2			
	Semester: V	Total contact hours: 30	L	T	P	
			1	1	0	
List of Prerequisite Courses						
	Physical Chemistry I and II, Transport Phenomena					
List of Courses where this course will be prerequisite						
	Environmental Engineering and Process Safety, Chemical Project Economics					
Description of relevance of this course in the B.Tech. Program						
Chemical Reaction Engineering is concerned with the utilization of chemical reactions on a commercial scale. This course is very relevant but not limited to the following industries: Inorganic chemicals, organic chemicals, petroleum & petrochemicals, Pulp & paper, Pigments & paints, rubber, plastics, synthetic fibres, Foods, Dyes and intermediates, Oils, oleo chemicals, and surfactants, Minerals, clean sing agents, Polymers and textiles, Biochemicals and biotechnology, pharmaceuticals and drugs, Microelectronics, energy from conventional and non-conventional resources, Metals						
Course Contents (Topics and subtopics)						
						Reqd. hours
1	Kinetics of homogeneous reactions, Interpretation of batch reactor data, Single ideal reactors including design aspects					8
2	Multiple reactions, Temperature, and pressure effects					3
3	Introduction to Non ideal flow, RTD measurements, Models to predict conversions					2
4	Homogeneous and Heterogeneous Catalysis, Kinetics of Solid Catalyzed Reactions. Design of gas – solid catalytic reactors					8
5	Introduction to Multiphase reactors					4
6	Mass transfer with chemical Reactions: Regimes of operation and Model contactors					5
	Total					30
List of Textbooks						
1	Elements of Chemical Reaction Engineering – H.Scott Fogler					
List of Additional Reading Material / Reference Books						
1	Heterogeneous Reactions, Vol.I and II –L.K. Doraiswamy, M.M.Sharma					
Course Outcomes (students will be able to.....)						
1	Describe and discuss principles of various types of reactors					
2	Calculate rates of reactions based on given reaction scheme					
3	Design various components of reactors used in industrial practice					
4	Compare various reactors and select an appropriate reactor for a given situation					
5	Describe and discuss principles of various types of reactors					

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	1	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	1	3	0	3	3	2	0	3	3
CO3	K3	3	3	2	1	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	0	2	3	3	1	3	3	1	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

PCC	Course Code: CET1807	Course Title: Chemical Engineering Operations	Credits = 2		
	Semester: V	Total contact hours:30	L	T	P
			1	1	0
List of Prerequisite Courses					
	Process Calculations, Transport Phenomena				
List of Courses where this course will be prerequisite					
	This is a basic course. It is required in many other courses that involve physical processes				
Description of relevance of this course in the B. Tech. Program					
This is a basic Chem Engg. course. The principles learnt in this course are required in almost all the courses and throughout the professional career of student					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Distillation: Fundamentals of flash, batch and continuous distillation, distillation columns internals, steam and azeotropic distillation				10
2	Liquid-Liquid Extraction: Solvent selection, construction of ternary diagrams, staged calculations, types of extraction equipment.				5
3	Crystallization: Phase diagram (temp/solubility relationship), evaporative and cooling crystallization, introduction to different types of crystallizers				5
4	Filtration: Mechanism of filtration, basic equation, constant volume, constant pressure filtration, rate expressions with cake and filter cloth resistances, compressible and incompressible cakes, introduction to various types of filters				5
5	Drying: Drying mechanism, drying rate curves, estimation of drying time and types of dryers				5
	Total				30
List of Text Books/ Reference Books					
1	Richardson, J.F., Coulson, J.M., Harker, J.H., Backhurst, J.R., 2002. Chemical engineering: Particle technology and separation processes. Butterworth-Heinemann, Woburn, MA.				
2	Seader, J.D., Henley, E.J., 2005. Separation Process Principles, 2 ed. Wiley, Hoboken, N.J.				
3	Svarovsky, L., 2000. Solid-Liquid Separation. Butterworth-Heinemann, Woburn, MA.				
4	McCabe, W., Smith, J., Harriott, P., 2004. Unit Operations of Chemical Engineering, 7 ed. McGraw-Hill Science/Engineering/Math, Boston.				
5	Green, D., Perry, R., 2007. Perry's Chemical Engineers' Handbook, Eighth Edition, 8 ed. McGraw-Hill Professional, Edinburgh.				
6	Dutta, B.K., 2007. Principles of Mass Transfer and Separation Process. Prentice-Hall of India Pvt. Ltd, New Delhi.				
Course Outcomes (students will be able to.....)					
1	Do basic sizing of continuous and batch distillation columns				
2	Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage				
3	Describe few industrial crystallization, filtration and drying equipment				
4	Describe the need and importance of other separation processes like adsorption, ion exchange and membrane				
5	Gain a practical perspective of unit operation in chemical industries				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	1	3	3	3	3	3	0	2	3	3
CO2	K4	3	3	2	3	2	3	2	3	3	2	3	2	3	3
CO3	K2	3	2	0	2	1	3	3	2	3	3	3	1	3	2
CO4	K2	3	2	1	2	0	3	3	3	3	1	3	1	2	2
CO5	K3	3	3	2	2	2	1	3	3	1	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

PCC	Course Code: OLT 1105	Course Title: SPL7: Technology of Oil and Fat Production and Edible Oil Processing	Credits = 4		
	Semester: V		Total contact hours:60	L	T
			3	1	0
List of Prerequisite Courses					
Chemistry of Oils and Fatty Acids					
List of Courses where this course will be prerequisite					
Technology of Oleochemicals					
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the mechanism, theory and practice of oil extraction. They will be able to explain refining of oils/ fats, fat modification processes.					
	Course Contents (Topics and subtopics)				Reqd hours
1	Natural sources of oils and fats, domestic and world production, trade and marketing of oilseeds and oils. Newer sources of oils and fats				5
2	Storage, sampling, grading, cleaning, crushing, and heat treatment of oilseeds				6
3	Mechanical expression, solvent extraction, rendering and other methods of recovering oils and fats. Economic aspects of these processes.				6
4	Specific methods for the production of palm oil, palm kernel oil and rice bran oil.				4
5	technical refining of oils for industrial uses, detoxification and technical products from oil cakes, edible products from oil meals, synthetic fatty material.				6
6	Antinutritional constituents of oilseeds. General methods of upgrading and utilization of oils, oil cakes and other products, Protein concentrates and isolates from oil meal				5
7	Processes and plants employed for refining, bleaching, deodorization,				6
8	hydrogenation and winterization of oils or edible purposes,				4
9	manufacture and evaluation of auxiliary materials such as activated earth and carbon, Ni catalysis and hydrogen				4
10	newer techniques of refining of oils and fats				5
11	manufacture of butter, margarine an ghee, Vanaspati, bakery and confectionery fats and fatty foods				5
12	composition and properties of these spoilage during storage of fats, and fat products, protection against auto oxidation				4
	Total				60
List of Text Books/ Reference Books					
1	Bailey's Industrial Oil and Fat Products Volume I to V by Daniel Swern, A Wiley Interscience Publication (1979)				
2	Palm oil by F. D. Gunstone, John Wiley and Sons (1987)				
3	Oils and Fats Manual (Vol. I & II) by A. Karleskind and J. P. Wolff, Lavoisier Publishing (1996)				
4	Oils, Fats and fatty foods by K. A. Williams, J. A. Churchill Ltd. (1966)				
5	Journal of American Oil Chemists' Society, International News on Fats, Oils and Related Materials, Lipids.				
6	Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)				
7	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Vol I & II, Industrial Consultants (India), (1994)				
8	Chemistry and technology of oils and fats by Prof. M. M. Chakrabarti, allied publishers (2003)				
9	Natural fatty acids and their sources by E. H. Pryde				
10	Hydrogenation of fats and oils by H. Patterson, Applied Science publishers (1983)				

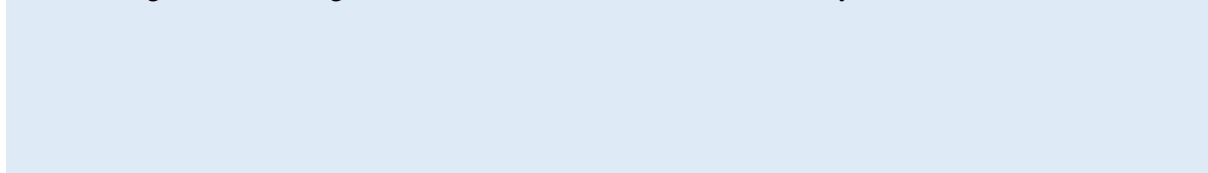
Course Outcomes (students will be able to	
1	Apply fundamental knowledge on basics of post harvest technology for oilseeds, chemistry involved in the oil /fat production and refining (K3)
2	Understand plant and processes for oil/ fat extraction (K2)
3	Evaluate the meal/ cake composition, and its upgradation by removal of antinutritional factors and detoxification (K5)
4	Develop various fat modification processes (K3)
5	Analyze composition and properties of fats, and fat products, and process development for its protection against auto oxidation (K4)



Mapping of Course Outcomes (COs) with Programme Outcomes (POs)																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4	
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3	
CO2	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2	
CO3	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
CO4	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3	
CO5	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain



PEC	Course Code: OLT 1117	Course Title: SPL8 : Spectroscopy of Organic Molecules	Credits = 4		
			L	T	P
	Semester: V	Total contact hours: 30 + 15 = 60	3	1	0
List of Prerequisite Courses					
Basic organic chemistry, Basic principles of quantum theory					
List of courses where this course will be prerequisite					
None					
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals and Surfactants Technology) Programme					
Students will understand the basic principles of advanced spectroscopy including infrared spectroscopy, ultra-violet spectroscopy and nuclear magnetic resonance spectroscopy which will pave the way to characterize organic compounds.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Introduction: Relating electromagnetic spectrum with electronic, vibrational, rotational energy levels of organic molecules.				2
2	Infrared (IR) Spectroscopy: Principles of vibrational spectroscopy, major modes of vibration, instrumentation. Functional group vibrations vs fingerprint region, factors influencing vibrational frequencies, identification of functional groups, effect of hydrogen bonding, correlation charts and tables, etc.				15
3	Ultraviolet-Visible (UV-Vis) Spectroscopy: Electronic transition in molecules; Frank-Condon principle, Jablonski diagram. Principles, instrumentation, Beer-Lambert law, presentation of UV-visible spectrum. Chromophore, effects of substituent on chromophores, studies of conjugated and extended conjugated systems, solvent effects, Woodward-Fieser rules.				10
4	Nuclear Magnetic Resonance (NMR) Spectroscopy: Basic concepts and principles, mechanism of resonance, diamagnetic anisotropy, chemical shift, factors that influence ¹ H-NMR chemical shifts. Spin-spin splitting, coupling constant, factors influencing coupling constant. Notations (AB, AX, ABC, ABX, AMX etc.). Typical ¹ H-NMR spectra of different compounds.				15
5	Tutorials				15
Total					60
List of Text Books/ Reference Books					
1	D. L. Pavia et al., Introduction to Spectroscopy, 5 th ed., Cengage learning, 2015.				
2	P. S. Kalsi, Spectroscopy of Organic Compounds, 6 th ed, New age international publishers, 2007.				
3	C. N. Banwell, Fundamentals of Molecular Spectroscopy, 3 rd ed., TMH, New Delhi, 1983.				
4	W. Kemp, Organic Spectroscopy, 3rd Ed., MacMillan, 1994.				
Course Outcomes (Students will be able to.....)					
CO1	Apply the knowledge to interpret IR spectra of organic molecules and gain idea about functional groups present in the molecule. (K3)				
CO2	Explain the origin of UV-visible absorptions and predict classify which organic compounds should exhibit visible color and which are transparent in the UV-visible range. (K2)				

CO3	Apply the knowledge to Interpret ¹ H-NMR spectra of organic compounds and predict direction of chemical shifts caused by various structural shielding or deshielding effects. (K3)
CO4	Analyze structure of organic compounds via these advanced spectroscopic techniques. (K4)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

PCC	Course Code: OLT	Course Title: HONOR 1: Byproducts Utilization and Waste Management	Credits = 4		
	Semester: V		Total contact hours: 60	L	T
			3	1	0

List of Prerequisite Courses

Chemistry of Oils and fatty acids, Chemistry of Surfactants and Oleochemicals

List of Courses where this course will be prerequisite

Project II

Description of relevance of this course in the B. Tech. (Oils) Programme

Students will understand the utilization of byproduct and waste management

	Course Contents (Topics and subtopics)	Reqd. hours
1	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.	9
2	Protein based surfactants, microbial surfactants	9
3	Utilization of oilseed hulls (groundnut, sunflower), husk (rice bran), shell (coconut, cottonseed) and residues, production of surfactants from protein residues	9
4	Utilization of Waste frying oils, glycerin from bio-diesel industry	9
5	Primary, secondary and tertiary treatments for waste water. Aerobic and non aerobic treatment, Chemical, biological and total oxygen demand, Carbon adsorption	9
	Tutorial	15
	Total	45

List of Text Books/ Reference Books

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

Course Outcomes (students will be able to

1	Understand basics of waste management (K2)
2	Evaluate possible utilization and value addition to the byproducts (K5)
3	Develop or synthesis of novel oleochemicals from waste streams/ byproducts (K3)
4	Evaluate and design various techniques for waste water treatments and pollution control (K5)
5	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
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2

CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

PCC	Course Code: OLP 1212	Course Title: Pr.4: Essential Oils laboratory	Credits = 2		
			L	T	P
	Semester: V	Total Contact Hours: 60	0	0	4
List of Prerequisite Courses					
Chemistry of oils, lipids, essential oils and their applications (OLT 1104),					
List of Courses where this course will be Prerequisite					
Technology of Oleochemicals (OLT 1112)					
Description of relevance of this course in the B. Tech. (Oils) Programme					
This course will help students to understand practical aspects of production and applications of essential oils. Students will get hands on experience in preparation, extraction, and various physical properties of essential oils.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Preparation of raw materials and extraction of various essential oils.				10
2	Determination of various physical parameters like refractive index, density, solubility etc				10
3	Determination of various indexes of essential oils like acid, Iodine, Peroxide, ester, carbonyl value etc.				10
4	Quality control analysis of essential oil by TLC method				10
5	Evaluation of essential oils by using Gas chromatography				10
6	Sensory analysis of essential oils and quality control check.				10
Total					60
List of Text Books/ Reference Books					
1	Essential oils (Vol. I to VI) by Guenther E.				
2	Perfume and flavour materials of natural origin by Arctander S.				
3	Perfume, Cosmetics and Soap by Poucher W., Chapman and Hall ltd., (1959)				
4	Perfumes, Soaps detergents and Cosmetics by S. C. Bhatia, CBC Publishers and Distributors (2001)				
Course Outcomes (Students will be able to.....)					
CO1	Understand the basic processes of extraction of different essential oils (K2)				
CO2	Selects appropriate processes for the extraction of essential oil (K3)				
CO3	Experiment on new techniques in production of essential oil.(K6)				
CO4	Perform analysis of essential oils (K4)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	2	3	2
CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	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

PCC	Course Code: OLP 1204	Course Title:Pr5: Evaluation and Testing of Soaps and Detergents	Credits = 2		
			L	T	P
	Semester: V	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
Chemistry of Oils and fatty acids, Production and Applications of soaps, surfactants and detergents					
List of Courses where this course will be prerequisite					
Processing of Soaps, Surfactants and Detergents laboratory					
Description of relevance of this course in the B. Tech. Programme					
Students will understand the evaluation and testing of soaps and detergents					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Preliminary evaluations of soap, Bathing soap: Determination of i) TFM, ii) Combined alkali, iii) Anhydrous soap. iv) moisture content, v) Wetting, vi) Foam stability Determination of chloride content, Determination of glycerol content by SMP method and unsaponifiable matter, Determination of synthetic surface active agents in given soap sample, To determine mushiness and cleaning efficiency of given soap sample For laundry soap: Determine i) TFM, ii) Unsaponifiable matter, iii) alkalinity and condensed phosphate, Iv) carbonate and total phosphate				20
2	Evaluation of detergent i) Moisture content, ii) Total available oxygen, iii) Foam stability, iv) Disc wetting, v) Acid value, vi) Bulk density, vii) Sodium silicate content For laundry detergent: Determine i) Active matter				20
3	To determine the borax content of given sample, To determine cloud point of given sample, Analysis of various cream: Physical evaluation and determine i) Total fatty matter, ii) Unsaponifiable matter, To study the principle of bottle , leaning				20
Total					60
List of Text Books/ Reference Books					
1	BIS methods for testing of soaps and detergents				
Course Outcomes (students will be able to					
1	Interpret analysis of soaps and detergents(K3)				
2	Evaluate performance properties of soaps and detergents(K5)				
3	Able to explain the composition of soaps and detergents (K4)				
4	explain the significance of various tests for soaps and detergents(K5)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO4	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; -No Contribution

Semester-VI

PCC	Course Code: OLT 1107	Course Title: SPL9: Cosmetics Science	Credits = 3		
			L	T	P
	Semester: VI	Total Contact Hours: 45	2	1	0
List of Prerequisite Courses					
Chemistry of Oleochemicals and surfactants (OLT 1102)					
List of Courses where this course will be Prerequisite					
Technology of Oleochemicals (OLT 1112), Processing of Soaps and Detergents and Surfactants and Triboapplications Laboratory (OLP 1211)					
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry of cosmetics products, raw materials and other ingredients required and their significance in cosmetics formulations. They will be able to explain its applications in various personal care products according to the chemistry involved and the requirement of end consumers.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Common ingredients used in cosmetics, surfactants, additives, antioxidants, preservatives. Equipments, plants and machinery used for manufacture.				7
2	Formulations of different cosmetic creams such as hair care products: Hair dressing cream, hair tonics, shampoos, antidandruff, depilatories, hair weaving preparations and straighteners.				8
3	Formulations of skin creams, hand cream, moisturizers, nail polish, lipsticks. Stability tests and product specifications Nail polish, lipsticks, face powders, baby toiletries				7
4	Dentifrices, Sun protection and sunscreen products, Antiperspirants, Deodorants, Shaving products, after shave products, Aerosol cosmetics.				8
5	Evaluation and Efficacy of cosmetics products. Stability tests and product specifications				7
6	Concept of product design, labeling, claiming and claim support understanding of current needs, translation of current needs to products				8
Total					45
List of Text Books/ Reference Books					
1	Modern Cosmetics by Thomssen, Universal Publishing Corporation (1951)				
2	Formulations and functions of cosmetics by Jellinek, Wiley Interscience 970)				
3	Chemistry and manufacture of cosmetics by Denavarre, Grosse farm				
4	Hand book of Cosmetic Science and Technology, Third Edition, André O. Barel Marc Paye, Howard I. Maibach				
5	Cosmetics, Science and Technology, Edward Sagarin 1957				
6	Poucher's Perfumes, Cosmetics and Soaps, Hilda Butler 2000 Cosmetics and Soaps 10th Edition				
Course Outcomes (Students will be able to.....)					

CO1	Understand the basic formulation of cosmetics (K2)
CO2	Selects the various ingredients and manufacturing processes for various cosmetics.(K4)
CO3	Develop formulations of different cosmetics products (K3)
CO4	Summarize stability analysis of cosmetic formulations . (K3)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)																
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4	
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2	
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3	
CO4	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3	
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3	

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

PCC	Course Code: OLT 1106	Course Title: SPL10: Production & Application of Soap, Surfactants and Detergents	Credits = 3		
			L	T	P
	Semester: VI	Total contact hours:45	2	1	0
List of Prerequisite Courses					
Chemistry of Oils and Fatty Acids, Chemistry of Surfactants and Oleochemicals					
List of Courses where this course will be prerequisite					
Technology of Oleochemicals					
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the mechanism, theory and practice of Surfactant production. They will be able to explain types of soaps, detergents and their formulations					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Raw materials for the soap industry, classification and selection of raw materials, properties of soaps and soap solution. Phases in soap boiling, processes employed in the manufacture of soap, various types of soaps and cleaning preparations, Testing and evaluation, Indian Standard Institution methods, essential oils and other				15
2	Detergents, their classification, raw materials, processes, and plants for the manufactures of detergents for domestic and industrial consumption, product evaluation, Indian Standard Institution Methods, essential oils and other ingredients for detergents.				15
3	Plant & processes for the production of important anionic, non-ionic, cationic and amphoteric surfactants. Fluorinated surfactants, new generation surfactants such as Gemini surfactants, silicon surfactants and sugar based surfactants				5
4	Application of soaps, surfactants and detergents in food, pharmaceuticals, textile, leather, surface coating, adhesives and other industries				10
Total					60
List of Text Books/ Reference Books					
1	Soaps by Prof. J. G. Kane				
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
3	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)				
4	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)				
5	Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)				
Course Outcomes (students will be					
1	Understand basics of soaps, surfactants and detergents (K2)				
2	Outline the plant and processes for soaps, surfactants and detergents (K4)				

3	Discuss upon raw materials and formulations of all types of surfactants for soaps and detergentsetc (K5)
4	Interpret the effect of use of new generation of surfactants in formulation and comment on quality standards of soaps, surfactants and detergents(K3)
5	Implement the use of surfactants in industrial applications(K3)

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

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO 2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K3+A+Psy	K3	K4
CO1	K 2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K 4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K 5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	K 3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO5	K 3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K 5	3	3	3	3	3	3	3	3	3	3	3	3	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

PEC	Course Code: OLT 1109	Course Title: SPL11: Supramolecular Chemistry of Nanomaterials	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 60	2	1	0
List of Prerequisite Courses					
Basic Organic, Inorganic and Physical Chemistry					
List of Courses where this course will be prerequisite					
Production and applications of soaps, surfactants etc., Advanced materials and Nanotechnology					
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals and Surfactants Technology) Programme					
Students will understand the chemistry of supramolecules and the importance of supramolecular interactions in the formation of host–guest complexes, various kinds of molecular self-assemblies including supramolecular polymers and self-assembly of nanoparticles.					
Sr. No	Course Contents (Topics and subtopics)				Reqid Hours
1	Introduction to supramolecular chemistry: Binding interactions in supramolecular chemistry: ion–ion, ion–dipole, dipole–dipole, hydrogen bonding, cation– π , π – π , van der Waals, and hydrophobic interactions. Concepts of host–guest chemistry and self-assembly.				10
2	Host–guest chemistry: Acyclic (podands) and cyclic (macrocycles) hosts, host-guest complexes, binding constant and selectivity.				10
3	Self-assembly in molecular systems: Self-assembly processes in metal-containing compounds, self-assembled supramolecular cages. Mechanically interlocked molecules: catenanes, rotaxanes.				10
4	Supramolecular polymers: Synthesis and study of various supramolecular polymers based on hydrogen bonding, π – π stacking, metal coordination and host-guest interactions.				10
5	Metal nanoparticles: Self-assembled monolayers (SAMs) on flat and curved substrate. Synthesis, structure and important properties of metal nanoparticles, ligand exchange etc.				10
6	Self-assembly of nanoparticles: Importance, self-assembly of nanoparticles via forces originated from nanoparticle cores, ligand shell and molecules added to the solution. Self-assembly of stimuli-responsive nanoparticles.				10
Total					60
List of Text Books/ Reference Books					
1	Core Concepts in Supramolecular Chemistry and Nanochemistry, Jonathan W. Steed, David R. Turner, Karl Wallace, Wiley, 2007 (ISBN: 978-0-470-85867-7).				
2	Supramolecular Chemistry: An Introduction, Fritz Vogtle, Wiley, 1991 (ISBN: 047192802X).				
3	References (journal articles) that would be provided during lectures.				
Course Outcomes (Students will be able to.....)					
CO1	Draw and understand the importance of intermolecular forces, calculate the energetics and observe topological view of structure. (K2)				
CO2	Interpret the logic behind the design of molecular building blocks towards the synthesis of varied self-assemblies including supramolecular polymers. (K3)				
CO3	Demonstrate various self-assembled architectures. (K3)				
CO4	Relate the effect of ligand structure to stabilize nanoparticles and self-assembly of nanoparticles. (K4)				
CO5	Utilize the acquired knowledge towards development of nano-technological devices. (K3)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

PCC	Course Code: OLT 1110	Course Title: SPI12 :Technology of Drying Oils and Resins	Credits = 4		
	Semester: VI	Total contact hours: 60	L 3	T 1	P 0
List of Prerequisite Courses					
HSC (Science)					
List of Courses where this course will be prerequisite					
Technology of Olochemicals, Processing of paints and printing inks, Paint technology laboratory.					
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry behind the resins. They will be able to explain the its applications in surface coating/ paints etc. according to the chemistry involved.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Classification of non drying, semi drying and drying oils. Processing of semidrying and drying oils. Acid refining, oxidative and thermal polymerization of oils and its mechanisms. Stand oils, blown oils, bodied oils. Chemistry of driers (Pb, Co, Mn, Zr, Fe, etc.) Dimer acids				12
2	Synthesis of alkyd resins. Fatty acid route, mono glyceride route, solvent process, fusion process, classification of alkyd resins according to oil length (short/ medium/ long oil), choice of polybasic acid				10
3	Chemical and physical modification of alkyd resins, uralkyd, epoxy esters, alkyl polyamide, silicon modified alkyd				10
4	Natural resins Natural resins classification, composition, physical and chemical properties of Rosin, shellac, Copl, manila				15
5	Synthetic Resins - Amino resins, urea formaldehyde, epoxy resins, and their application, polyamide resin, chlorinated rubbervinyl resins. Polyurethanes, classification, properties and application				13
	Total				60
List of Text Books/ Reference Books					
1	Organic Coating Technology by H. F. Payne.				
2	Polymer and Resins; Their Chemistry and Chemical Engg, Brage Golding, D.VanNostrand Company Inc, 1959.				
3	Organic Coating: Science and Technology by Z. Wicks.]				
4	Handbook of Thermoplastics, O. Olabisi, Marcel Dekker, 1997				
5	Introduction to Polymer Science and Technology by H. S. Kaufman and J. J. Falcetta, Wiley – Interscience Publication, 1977				
6	Introduction to paint chemistry – Principles of paint technology, Turner G.P.A., Chapman and Hall , London				
Course Outcomes (students will be able to					
CO1	Understand fundamental knowledge on basics of chemistry involved in the drying Oils (K2)				
CO2	Discuss the types of drying Oils, resins and their applications (K4)				
CO3	Summarise about synthetic methods used for manufacture of alkyd resins (K3)				

CO4	Classify different types of resins and drying Oils on the basis of application and its properties . (K4)
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Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

PCC	Course Code: OLT 1126	Course Title: Honors 2: Modern Analytical Techniques	Credits = 4		
	Semester: VI	Total contact hours: 60	L	T	P
			2	1	0

List of Prerequisite Courses

Chemistry of Oils, Physical Chemistry

List of Courses where this course will be Prerequisite

Processing of Soaps, Surfactants and Detergents and Triboapplications laboratory

Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme

To acquaint the students with natural, nature identical and synthetic perfumery chemicals; structure, synthesis and applications of fragrance chemicals.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	UV, IR and NMR: sample preparation, principle, analysis and interpretation	15
2	GC, HPLC and Mass Spectrometry: Principle, instrumentation, Solvents, Detectors, Columns, sample preparation etc.	15
3	AAS, DSC and TGA: working principle, instrumentation, interpretation	15
4	Tutorials	15
Total		60

Course Outcomes (Students will be able to.....)

CO1	Understand the fundamental knowledge on instrumentation (K2)
CO2	Distinguish between various analytical and instrumental techniques (K4)
CO3	Apply the fundamental knowledge for various oleochemicals (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	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

VSEC	Course Code: CEP1714	Course Title: Chemical Engineering Laboratory	Credits = 2		
	Semester: VI	Total contact hours: 60	L	T	P
			0	0	4
List of Prerequisite Courses					
	Process Calculations, Transport Phenomena, Chemical Engineering Operations, Chemical Reaction Engineering				
List of Courses where this course will be prerequisite					
	Other B. Tech. courses				
Description of relevance of this course in the B. Tech. Program					
Chemical Engineering lab provides students the firsthand experience of verifying various theoretical concepts learnt in theory courses. It also exposes them to practical versions of typical chemical engineering equipment's and servers as a bridge between theory and practice. This particular lab focuses on fluid dynamics, distillation, filtration, drying and sedimentation.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	4 - 6 Experiments on fluid dynamics and heat transfer				24
2	3 - 5 Experiments on Chemical Engineering Operations				16
3	2 - 4 Experiments on Reaction Engineering				12
4	1 - 3 Experiments on process dynamics and control				8
	Total				60
List of Text Books/ Reference Books					
1	McCabe W.L., Smith J.C., and Harriott P. Unit Operations in Chemical Engineering, 2014				
2	Bird R.B., Stewart W.E., and Lightfoot, E.N. Transport Phenomena, 2007				
3	Coulson J.M., Richardson J.F., and Sinnott, R.K. Coulson & Richardson's Chemical Engineering: Chemical engineering design, 1996.				
4	Green D. and Perry R. Perry's Chemical Engineers' Handbook, Eighth Edition, 2007.				
Course Outcomes (students will be able to.....)					
1	Learn how to experimentally verify various theoretical principles				
2	Visualize practical implementation of chemical engineering equipment's				
3	Develop experimental skills				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	1	2	3	3	0	3	3	3	2	2	3
CO3	K4	3	3	2	3	2	2	3	3	3	3	2	2	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

PCC	Course Code: OLP 1202	Course Title: PR6: Processing of Oleochemicals & Waxes and Cosmetics Formulations	Credits = 2		
	Semester: VI		Total contact hours: 60	L	T
			0	0	4
List of Prerequisite Courses					
Chemistry of Oils and Fatty Acids, Production and Application of Soaps, Surfactants and Detergents					
List of Courses where this course will be prerequisite					
Cosmetics Science, Technology of Oleochemicals					
Description of relevance of this course in the B. Tech. (Oils) Program					
Students will understand the mechanism, theory and synthesis of oleochemicals and waxes formulations. They will be able to understand/ explain types of cosmetics and their formulations					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Methyl esters from oil, fatty acids, acid oil, frying oil etc. preparation and properties				20
2	Selective hydrogenation of oil for preparation of Vanaspati				15
3	Fatty acids by saponification and acidulation, high pressure fat splitting				15
4	metallic soap by double decomposition and fusion method				10
5	Rice bran wax processing (separation of fatty acid and fatty alcohol)				15
6	Study in esterification reaction of butyl esters, reaction kinetics				15
7	Alkyd resins and Wax esters				10
8	Formulation and physical quality/ efficacy parameters for cosmetics formulations : Lipstick, Men's hair dressing cream, After shave lotion, Shaving cream, Cleansing milk, Foundation lotion, Eye shadow, Nail polish, Face scrub, Vanishing cream, Toothpaste. Mouthwash. Anti-Dandruff shampoo				20
	Total				120
List of Text Books/ Reference Books					
1	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
2	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)				
3	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)				
4	Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)				
5	Poucher's Perfumes, Cosmetics and Soaps by Hilda Butler				
Course Outcomes (students will be)					
1	Apply synthesis knowledge for developing a oleochemical molecule (K3)				
2	Explain the reaction chemistry, for synthesis of various oleochemicals (K2)				
3	Evaluate properties and quality parameters of oleochemicals (K5)				
4	Create various cosmetics formulations (K6)				
5	Analyze the properties/ physical quality parameters and efficacy of cosmetics formulations (K4)				

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO3	K5	3	3	3	2	3	3	3	3	3	3	3	3	3	3
CO4	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

K, knowledge evel from cognitive domain; A, Affective domain; S, Psychomotor domain

PCC	Course Code:	Course Title: Pr4: Paint Technology Laboratory	Credits = 2		
	OLP 1206		L	T	P
	Semester: VI	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
HSC (Science)					
List of Courses where this course will be prerequisite					
Technology of Olochemicals, Chemistry and Technology of Drying Oils and Resins, Processing of paints and printing inks.					
Description of relevance of this course in the B. Tech. (Oils) Programme					
This laboratory will help to understand students the chemistry of different drying oils and resins. They will be able to explain the its applications in surface coating/ paints etc. according to the chemistry involved.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	To prepare alkyd resin and its analysis				6
2	Preparation and evaluation of short oil/long oil resin varnishes				5
3	Preparation and evaluation of Epoxy resin				6
4	Analysis of resins for Acid value, Hydroxy value % solids, Viscosity, Drying, Adhesion, Hardness and resistance characteristics.				5
5	To prepare the red oxide metal primer and evaluation of its properties				6
6	Analysis of paint properties like hiding power, drying, DPUR etc				5
7	Preparation of varnishes and preliminary analysis of products.				6
8	Analysis of General purpose air-drying paint as per the specification.				5
9	Formulation of wall finishes and its analysis.				6
10	Preparation and Analysis of Emulsion paint as per the IS specification.				5
11	Preparation and Analysis of Aluminum paint as per the IS specification				5
	Total				60
List of Text Books/ Reference Books					
1	The Testing of Paints, Vol – V, Paint Technology Manual, Dunkley F.G. and Collier, C.W., Chapman and Hall.London				
2	Paint film defects and their remedies, Manfred, H., Chapman and Hall Ltd. London.				
3	Introduction to paint chemistry – Principles of paint technology, Turner G.P.A., Chapman and Hall , London				
4	OCCA Surface Coating Technology Vol, 1 & 11				
5	Paint Technology Manuals., Oil and color chemists Association, Vol-I – Vol. VIII, Chapman and Hall , London				
Course Outcomes (students will be able to					
1	Understand fundamental knowledge on basics of chemistry involved in the Paints (K2)				
2	Classify different types of resins, Pigments and additives with respect to their properties and their applications (K4)				
3	Summarise methods used for manufacture for different paints. (K3)				
4	Discuss on different properties of paints on the basis of applications. . (K4)				

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

Semester-VII

PCC	Course Code: OLT 1115	Course Title: SPL13:Petroleum Technology	Credits = 3		
	Semester: VII	Total contact hours: 45	L	T	P
			2	1	0
List of Prerequisite Courses					
Functional Fluids and Performance Chemicals					
List of Courses where this course will be prerequisite					
Project II					
Description of relevance of this course in the B. Tech. Programme					
Students will understand the petroleum refining operation and technology for petrochemicals					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction to crude oil, Sour crude and sweet crude, physicochemical properties, composition. National and global petroleum scenario				7
2	Processes in the Petroleum Refining Industry: Crude Oil Distillation, Petroleum and gas preparation, Formation of petroleum emulsions and their basic properties, Separation of water-oil emulsions, Mechanical petroleum drying, Thermal petroleum drying, Chemical methods of petroleum drying.				5
3	Refinery products: Low-Boiling Products, Gasoline, Distillate Fuels, Jet and Turbine Fuels. Automotive Diesel Fuels, Railroad Diesel Fuels, Heating Oils, Residual Fuel Oils. Associated gas, LNG, CNG, LPG etc. and its utilization, storage and				8
4	Processing of Light and Heavy Distillates, Thermal cracking, Catalytic cracking, Visbreaking, Coking, Hydroprocessing				5
5	Processing heavy residue fraction using solvents. Source of such solvents. Process diagram for Atmospheric distillation unit (ADU) and vacuum distillation unit (VDU).				5
6	Catalytic cracking: FCC Feed Pretreating, Process Variables.				5
7	Petroleum waxes/ asphalt/ other residues and its properties. Dewaxing: typical operating conditions and outlets for the wax produced. Detergent grade α -olefins, manufacture of alcohols and high temperature lubes. Advantages and limitations				5
	Tutorial				10
	Total				45
List of Text Books/ Reference Books					
1	Crude Oil Chemistry by Vastly Simanzhenkov and Raphael Idem				
2	Petroleum Refining <i>Technology and Economics</i> (Fourth Edition) by James H. Gary and Glenn E. Handwerk				
3	Refining processes Handbook by Surinderparkash				
Course Outcomes (students will be					
1	Understand basics of crude oil, national and international scenario K2				
2	Summarise the processes for petroleum refining K3				
3	Summarise the plant and processes for petrochemicals K3				
4	Able to explain the key processes and products from petroleum K3				
5	Able to explain the various applications of petrochemicals K4				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2

CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO5	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

PCC	Course Code: OLT 1112	Course Title: SPL14: Technology of Oleochemicals	Credits = 2		
			L	T	P
	Semester: VII	Total Contact Hours: 30	1	1	0
List of Prerequisite Courses					
Chemistry of Oleochemicals and surfactants (OLT 1102), Chemistry of Oils and fatty acids (OLT 1101),					
List of Courses where this course will be Prerequisite					
Petroleum Technology (OLT 1115), Byproduct utilization and waste management (OLT 1114)					
Description of relevance of this course in the B. Tech. (Oils) Programme					
Students will understand the chemistry and technology of Oleochemicals involved while processing and manufacturing various Oleochemicals. They will be able to explain its synthesis, applications in various processes, evaluation techniques and schemes according to the chemistry involved.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Fatty acids, theory and practice of fat splitting, and purification of products				5
2	Separation of fats and fatty acids, fractional distillation				5
3	Miscellaneous applications of oleochemicals in food, pharmaceutical, textile, plastic, leather and other industries				5
4	Glycerine: Processes for treatment of sweet water and spent soap lye, Manufacture of glycerine from natural sources. Synthetic glycerin, grades of glycerin, properties and utilization of glycerine				5
5	Miscellaneous fat-based produced: Manufacture and utilization of nitrogen, phosphorous and sulfate containing products				5
6	Products obtained by interesterification, hydrogenation, oxidation and pyrolysis. Metallic soaps.				5
Total					30
List of Text Books/ Reference Books					
1	Glycerin, Key cosmetic ingredient by Eric Jugermann, Marcel Dekker Inc., (1991)				
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
3	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
4	Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)				
5	Natural fatty acids and their sources by E. H. Pryde				
6	Fatty Acids by Markley K. S. Vol. I to IV, Robert E. Krieger publishing Co. (1973)				

6	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)
7	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)
8	Manufacture of soaps, other detergents and glycerin by E. Woollatt, John Wiley and Sons (1985)
Course Outcomes (Students will be able to.....)	
CO1	Able to understand the basic process of manufacture of different oleochemicals (K2)
CO2	Select appropriate process for the manufacture of oleochemicals (K4)
CO3	Summarise about advanced method of analysis of oleochemicals. (K3)
CO4	Select specific method for the identification of particular oleochemical and understand its properties. (K4)

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

PEC	Course Code: OLT 1119	Course Title: Dept Elective I: Product Management	Credits = 3		
	Semester: VII		Total Contact Hours: 45	L	T
			2	1	0
List of Prerequisite Courses					
None					
List of Courses where this course will be prerequisite					
Marketing Management, Product Management, Product Design					
Description of relevance of this course in the B. Tech. Program					
The course introduces the students to key concepts of product management – Marketing Planning, Competition mapping, Product Category Awareness, Customer analysis, Developing Product Strategy, Product Life Cycle Management. At the end of the course the student will be able to convert the exact consumer or customer requirement in a tangible product form. He will be in a position to design a perfect Product Mix which will cater to exact requirements of a Consumer / customer					
	Course Contents (Topics and Subtopics)				Required Hours
1	Introduction to Product Management, Role of a Product Manager, changes affecting Product Management				8
2	Elements of a product Strategy, Setting Objectives, Factors affecting selection of Strategy, Product Life Cycle Management, Relation to Customer Strategy, Managing Brand Equity, Case Studies				5
3	Definition and objective of Marketing Plans, Frequent Mistakes in the planning process, Approaches for a planning process, Steps in planning process, Components of a Marketing Plan, Case studies				10
4	Identifying and , Methods for determining Competitors, Competitor Selection Defining Market segments, Creating a Product Feature Matrix, Assessing Competitors Current Objectives and strategies, Marketing Strategy, Differential Advantage Analysis Case Studies				10
5	Aggregate Market Factors, Factors affecting product category, Environmental Analysis (PESTLE Analysis), Case studies				5
6	Detail analysis of the customer prior designing the product, Customer Segmentation, Case Studies				7
	Total				45
List of Textbooks/Reference Books					
1	Product Management, Donal R. Lehman, Russell S. Winer				
2	Consumer Behaviour, Buying, Having and Being, Michael R. Solomon				
3	Strategic Brand Management, Kevin Lane Keller, Ambi M. G. Parmeshwaran, Issac Jacob				
Course Outcomes (Students will be able to.....)					
CO1	Understand role of product manager (K2)				
CO2	Identify market segment for a product (K3)				
CO3	explain strategies for a product to be effectively marketed(K2)				
CO4	Identify competitors for new product (K3)				

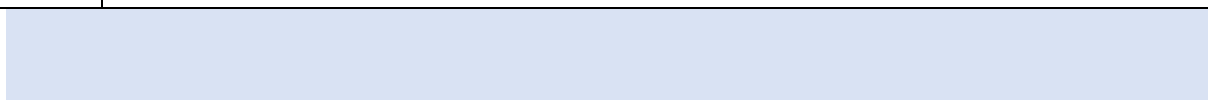
Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2

CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO4	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; - No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

PEC	Course Code: OLT 1120	Course Title: Dept Elective II: New Product Development	Credits = 3		
	Semester: VI		Total Contact Hours: 45	L	T
			2	1	0
List of Prerequisite Courses					
None					
List of Courses where this course will be prerequisite					
Product Management					
Description of relevance of this course in the B. Tech. Program					
The course introduces the students to key concepts of New Product Development – Ideation, Idea Screening, Concept Testing, and Commercial Viability of a Product, Product Development, Product Testing and Commercialization. He will be in a position to Design and Develop Product which will fulfill the Unmet need of the Consumer					
	Course Contents (Topics and Subtopics)				Required Hours
1	Why One requires a New Product Development (NPD) Strategy, Types of NPD Strategies				7
2	What is Ideation, Steps in Ideation, How to Conduct an Ideation Session, Factors affecting the Ideation session outcome, What is Point of View (POV), Defining POV, Characteristics of POV, Case studies				8
3	Factors affecting screening Ideas, Product Concept Designing and Testing, Inputs for a Concept design and outputs of a Concept, Sample Concept statements, Case Studies				8
4	Concept Testing Methodologies, Monadic, Sequential Monadic, Paired Comparative				7
5	Assessing Commercial Viability of a Product and Metrics used for the same, Capital Asset Pricing Model (CAPM),				8
6	Detail analysis of the customer prior designing the product, Customer Segmentation, Case Studies				7
	Total				45
List of Textbooks/Reference Books					
1	Concept Testing, David Schwartz				
2	Design Thinking: New Product Development Essentials from the PDMA by Michael G. Luchs, Scott Swan				
3	New Product Development: from Initial Idea to Product Management, Marc Annachino				
4	Ideation: The Birth and Death of Idea, Douglas Graham				
5	Marketing Management, Philip Kotler, Kevin Lane Keller				
6	Corporate Finance, Stephen A Ross, Randolph W Westerfield, Jeffrey Jaffe, Bradford D Jordan				
Course Outcomes (Students will be able to.....)					
CO1	Explain prerequisite for new product development (K2)				
CO2	Analyze commercial viability of product (K4)				
CO3	Explain strategies in new product development (K2)				



Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
	K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4	

CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
Course	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3

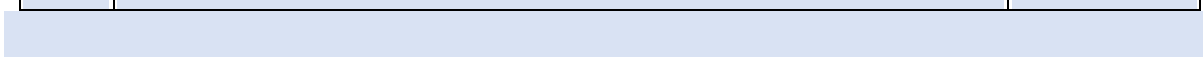
3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; - No Contribution

K, knowledge level from cognitive domain; A, Affective domain; S, Psychomotor domain

	Course Code: OLT1127	Course Title: Honors III: Optimization Techniques	Credits = 3		
			L	T	P
	Semester: VIII	Total contact hours: 30 + 15 = 45	2	1	0
List of Prerequisite Courses					
Physics, chemistry					
List of Courses where this course will be Prerequisite					
Project I and II					
Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme					
To acquaint the students with natural, nature identical and synthetic perfumery chemicals; structure, synthesis and applications of fragrance chemicals.					
Sr. No.	Course Contents (Topics and subtopics)				Required Hours
1	Basic statistical concepts, experimental design, analysis and interpretation				15
2	Linear algebra and matrices, MATLAB, Vector Space				05
3	Linear Programming, unconstraint optimization, constraint optimization, non linear problems				10
4	Tutorials				15
Total					60
Course Outcomes (Students will be able to.....)					
CO1	Understand the fundamental knowledge on various optimization techniques (K2)				
CO2	Access the importance of experimental design (K4)				
CO3	Design a regression model (K5)				

RM I	Course Code: OLT1130	Course Title: Literature Review (Research Methodology – I)	Credits = 2		
	Semester: VII	Total contact hours: 45	L	T	P
			1	0	2
Course Outcomes (students will be able to.....)					
List of Prerequisite Courses					
1	NA				
List of Courses where this course will be prerequisite					
1	NA				
Description of relevance of this course in the B. Chem. Engg. Program					
The formal exposure to various elements of research methods such as problem formulation, literature search, planning of various activities, documentation, budgeting, purchase, report/thesis compilation, manuscript writing, patent drafting, is critical for polishing the naïve research attitude and aptitude in the PG students of the programme. The course is designed to formally introduce various concepts of research methodology in stepwise manner to the students					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Introduction of Course Academic Honesty Practices General philosophy of science & Arguing About Knowledge Case studies in science history				3
2	Motivation and Background Motivation/Demotivation for Research, Building Background for Research and How to read research papers				3
3	Time Management (Academic and Non-academic time), Effort Management, Plan execution, Energy Management Issue, Role and expectation of research supervisor and student				4
4	Finding and Solving Research Problems What is Research, How to start?, Approaches to find research problems and psychological experiments Literature survey, Textbooks, Review and research papers How to ask Questions What is worthwhile research problem, Analytical and synthetic research approach				4
5	Finding and Solving Research Problems What is Research, How to start?, Approaches to find research problems and psychological experiments Literature survey, Textbooks, Review and research papers, critical review of research papers, how to write literature survey report, How to ask Questions, formulating research questions,				4
6	What is worthwhile research problem, Analytical and synthetic research approaches How to solve research problems, designing work plan, importance of objectives, activity and strategizing research work. Design of timeline for work plan (Gantt Chart etc), Grant Writing Guidelines				4
7	Experimental Research Inventory Management, Material Management Learning required skills for research, Documentation and lab notebook guidelines, Safety aspects in chemical/biological research				4
8	Methods and Tools used in Research: Qualitative studies; Quantitative studies; Simple data organization; Descriptive data analysis; Limitations and sources of error; Inquiries in form of Questionnaire, Opinionnaire or by interview; Statistical analysis of data including Variance, Standard deviation, Students 't' test and Analysis of variance (ANOVA), Correlation data and its interpretation, Computer data analysis				6
9	Scientific Writing Skeleton of research paper, author guidelines, good writing skills, importance of discussion, Macro-level discussion.				6

	Structure of the documents. General issues of presentability. Micro-level discussion. Stylistic issues. Examples of bad and good writings.	
10	Publishing and Reviewing Publication process, How to publish papers, where to submit, Review process and reacting to a review report Reviewing scientific papers	4
11	Scientific Norms and Conventions Authorship. Plagiarism. Simultaneous submissions. Reviewing norms. Referring to other papers. Use of data. Collaborative Research Work	3
List of Textbooks		
	Menzel, D.; Writing a Technical Paper; McGraw-Hill, United States (1961).	
	Best, J. W., Kahn, J. V., Jha, A. K.; Research in Education; 10th ed.; Pearson, New Delhi, India (2005)	
List of Additional Reading Material / Reference Books		



Course Outcomes (Students will be able to.....)	
CO1	Understand the basic concepts of research and the components therein, formally (K2)
CO2	Understand and appreciate the significance of statistics in Chemical Technology, Pharmacy and Chemical Engineering (K2)
CO3	Understand and apply importance of literature survey in research design (K3)
CO4	Understand an in-depth knowledge on the documentation in research(K2)
CO5	Evaluate importance of various parts of a research report/paper/thesis in presentation of research results(K4)
CO6	Prepare and Deliver a model research presentation (K5)
CO7	Understand the significance of various types of IPRs in research(K1)
CO8	Create a model research project(K6)



RM II	Course Code: OLP1219	Course Title: Design and Analysis of Experiments (Research Methodology – II)	Credits =2		
	Semester: VII	Total contact hours: 45	L	T	P
			1	-	2
List of Prerequisite Courses					
	Applied Mathematics I				
List of Courses where this course will be prerequisite					
	This course is required for graduating engineers to function effectively in Industry, Academia and other professional spheres. This course is in Semester VIII				
Description of relevance of this course in the B.Tech. Program					
Modern day manufacturing activities and R&D activities need decisions taken with a scientific rigour and should be well-supported by 'statistics'. Chemical Technologist graduates who will serve industry as well as postgraduate research students who will serve industry, R&D organisations, or academic research should have a reasonably good background of statistical decision making. This also involves extraction of meaningful data from well-designed minimal number of experiments at the lowest possible material costs. This course will also help the students in all domains of their life by imparting them a vision for critical appraisal and analysis of data.					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Fundamental principles of classical design of experiments Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.				4
2	Review of Probability and basic statistical inference: Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions, Hypothesis testing.				3
3	Experiments with a Single Factor: The Analysis of Variance Fixed effect model and Random effect model, Model adequacy checking, Contrasts, Orthogonal contrasts, Regression Models and ANOVA, Violation of Normality Assumption: Kruskal-Wallis test. Randomized block designs, Latin square designs, Balanced Incomplete Block Designs				6
4	Factorial designs: Definition, Estimating model parameters, Fitting response curves and surfaces.				3
5	The 2 ^k Factorial Design, Blocking and Confounding in the 2 ^k Factorial Design; Focus of 2 ² and 2 ³ designs, Blocking and Confounding in the 2 ^k Factorial Design.				6
6	Plackett Burman methods, Central Composite Design (CCD)				3
7	Descriptive Statistics, Probability Distribution and testing of Hypothesis using R				4
8	Regression techniques, diagnostic checks, ANOVA using R and implementation of contrasts.				4
9	Construction of Balanced Incomplete Block Designs and data analysis using R				4
10	Analysis of factorial designs using R, understanding output and interpretation.				4
11	Factorial designs, Data analysis and interpretation.				4
List of Text Books / Reference Books					
1	Douglas C. Montgomery, Design and Analysis of Experiments, 8 th Edition, John Wiley & Sons, Inc. 2013				
2	Box, G. E., Hunter, W.G., Hunter, J.S., Hunter, W.G., Statistics for Experimenters: Design, Innovation, and Discovery, 2nd Edition, Wiley, 2005.				
3	John Lawson, Design and Analysis of Experiments with R, CRC Press, 2015				
4	Dieter Rasch, Jürgen Pilz, Rob Verdooren, Albrecht Gebhardt Optimal Experimental Designs with R. CRC Press, 2011.				
5	José Unpingco, Python for Probability, Statistics, and Machine Learning, Springer, 2019				
6	Response Surface Methodology: Process and Product Optimization using Designed Experiments: R. H. Myers, D. C. Montgomery.				
7	Introduction to Statistical Quality Control: D. C. Montgomery.				
8	Design of Experiments in Chemical Engineering: Živorad R. Lazić.				
Course Outcomes (students will be able to.....)					
1	Students should be able to understand basic principles of design of experiments.				

2	Students should be able to perform statistical analysis of single experiments and do post hoc analysis.	
3	Students should be able to conduct experiment and analyse the data using statistical methods.	
4	Students should be able to choose an appropriate design given the research problem.	
5	Students should be able to perform statistical analysis of different designs using R and interpret the results.	

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	2	2	2	2	3	3	3	1	2	3	2	3	1
CO3	K3	3	3	2	2	1	1	3	3	3	3	3	2	2	3
CO4	K3	3	3	2	2	2	3	0	2	3	3	3	2	3	1
CO5	K3	3	2	2	0	2	3	3	3	1	3	0	2	3	3
Course	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

Project	Course Code: OLT1216	Course Title: Project – I	Credits = 4		
			L	T	P
	Semester: VII	Total Contact Hours: 120	0	0	8
List of Prerequisite Courses					
Research Methodology					
List of Courses where this course will be prerequisite					
Project – II					
Description of relevance of this course in the B. Tech. Program					
The course is designed to help students develop a skill-set for solving a research problem related to Pharmaceutical Sciences and Technology. The course presents an opportunity to the students for fine-tuning their scientific communication skills, oral as well as written.					
	Course Contents (Topics and Subtopics)				Required Hours
1	The Teachers will communicate various research topics of potential interest to the Pharmaceutical Sciences and Technology field to all the students based on the interest and facilities available. Each student, based on his/her interest and merit, selects the research topic and is allotted a supervisor. The work involves detailed review of the literature, formulation of research project, hypothesis, objectives, methodology, possible expected outcomes, planning for experimentation, experimental trials, data generation and analysis. Finally, the student will compile the report as per the communicated format and then present in front of the Evaluators.				120
	Total				120
List of Textbooks/Reference Books					
1	Relevant research articles, patents, review articles, conference proceeding, book chapters and books				
Course Outcomes (Students will be able to.....)					
CO1	Develop critical thinking to identify the research gap for the project (K5)				
CO2	Formulate a scientific question and approach to solve it (K6)				
CO3	Plan the experimental methodology for the project (K5)				
CO4	Develop skills to communicate the research plan effectively (K6)				
CO5	Develop skills for writing a scientific document on the research work (K6)				

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
--	--	-----	-----	-----	-----	-----	-----	-----	-----	-----	------	------	------	------	------

		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K6	3	3	3	3	3	3	3	3	3	3	2	3	3	1
CO3	K5	3	2	3	3	3	3	3	1	3	3	3	3	3	3
CO4	K6	3	3	3	3	3	2	3	3	3	0	3	3	2	3
CO5	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

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PCC	Course Code: OLT 1210	Course Title: PR8: Processing of soaps and detergents and surfactants	Credits = 2		
			L	T	P
	Semester: VII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
Production and Applications of Soaps, Surfactants and Detergents. Functional Fluids and Performance Chemicals					
List of Courses where this course will be prerequisite					
Project II					
Description of relevance of this course in the B. Tech. Programme					
Students will understand soap, detergent formulations and its evaluation. Luricant testing					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Analysis of soap noodles, and commercial toilet soap, bathing bar, laundry soap, liquid soap, transparent soap, shaving soap. Analysis of linear alkyl benzene sulphonic acid and commercial detergents				15
2	Synthesis various anionic, cationic, nonionic and amphoteric surfactants like naphthalene sulphonates, turkey red oil, sulphated oils. DEG, PEG and poly glycerol, condensation products of ethanol amides, benzalkonium chloride, Quarternary ammonium compounds, betains and sulphobetains etc.				15
3	Application of surfactants: Formulation using surfactants like floor cleaner, detergent, cosmetics, etc.				15
4	Study experiments on classification of soaps, Classification of surfactants with one example and a method of preparation, Auxiliary chemicals used in soaps and detergents (builders, fillers etc.)				15
5	Flash point, Viscosity and viscosity index of lube oil samples, pour point, oxidation stability test, Copper corrosion test for lube oil, grease testing, carbon residue of the lube oil sample, Wear scar test for lube oil (4 ball weld load apparatus), Extreme pressure test for a lubricant (4 ball weld load apparatus).				12
	Total				60
List of Text Books/ Reference Books					
1	Soaps by Prof. J. G. Kane				
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)				
3	Fatty acids in industry by R. W. Johnson, Marcel Dekker Inc. (1989)				
4	Fats, Oleochemicals and surfactants challenges in 21 st Century by V. V. S. Mani and A. D. Shitole, Oxford and IBH Publishing Co. Pvt. Ltd. (1997)				
5	ASTM standards for testing of petrochemicals				
Course Outcomes (students will be able to					
1	Classify raw materials for soap formulation and its analysis (K4)				
2	outline the synthesis of various types of surfactants (K4)				
3	Develop detergent formulation and its analysis (K6)				
4	summaries on application of surfactants for various home and personal care products (K3)				
5	explain the various testing methods for lubricants (K2)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	Psy	K3	Affec	K2+A	K3	A+Psy	K3	K4
CO1	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

Semester-VIII

PCC	Course Code: OLT	Course Title: SPL15: Functional Fluids and Performance Chemicals	Credits = 3		
	Semester: VIII		Total contact hours: 45	L	T
			2	1	0

List of Prerequisite Courses

Chemistry of Oils and fatty acids

List of Courses where this course will be prerequisite

Petroleum Technology

Description of relevance of this course in the B. Tech. Programme

Students will understand the base oil technology (petroleum and biobased), properties and applications

	Course Contents (Topics and subtopics)	Reqd. hours
1	Introduction to functional fluids and applications. Basics of tribology, Fundamentals of Friction, Wear & Lubrication, Hydrodynamic & Elasto hydrodynamic lubrication, boundary lubrication, viscosity, viscosity index. Functions and applications of	7
2	Classification of lubricants according to application & types, Terminology/ Glossary used in lubrication, General properties of lubricants as well as their performance characteristics. Performance, quality & viscosity of lubes. Comparison between solid, semisolid, liquid and gaseous lubricants	7
3	Petroleum based, synthetic and vegetable oil based lubricants: properties and applications	8
4	Re-refining of waste lube oils: physical and chemical processes. Advantages and limitations	4
5	Analytical test methods (Basic methods like Acid & Base Number, Viscosity, Specific Gravity, Pour Point, Flash Point & Fire Point, Boiling Range, Carbon Residue, oxidation stability etc.	6
6	Greases: definition, types, classification, raw material, manufacturing process, specifications and applications.	4
7	Performance chemicals: sulfochlorinated and sulfurised compounds, polymers, phosphate esters as extreme pressure, antiwear, pour point depressant, viscosity index improvers, multifunctional additives: Synthesis, properties and applications.	4
8	Engine coolants: purpose, composition (glycerol, polyglycerol and MEG based), manufacturing process, properties.	5
	Total	45

List of Text Books/ Reference Books

1	Lubricants and Lubrication Edited by Theo Mang and Wilfried Dresel
2	Lubricants and special fluid by Vaclav stgpina and Vaclav Vesely
3	Chemistry and Technology of Lubricants Edited by Roy M. Mortier Malcolm F. Fox and

Course Outcomes (students will be able to

1	Understand basics of lubricants and functional fluids (K2)
2	Evaluate properties and functions of various types of base oils (petroleum and biobased) (K5)
3	Summaries about methods of synthesis and analyze properties of performance chemicals (K3)
4	Explain and evaluate the various properties and applications of functional fluids and performance chemicals (K5)
5	Apply technology for regeneration of waste lube oil, engine coolants and greases (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	Psy	K3	Affec	K2+A	K3	A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO4	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3	3	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

PCC	Course Code: OLT1128	Course Title: Honors 4: Alternative Fuels and Energy	Credits = 4		
	Semester: VIII	Total contact hours: 30 = 60	L	T	P
			2	1	0

List of Prerequisite Courses

Chemistry of oleochemicals and surfactants, Tehnology of oleochemicals

List of Courses where this course will be Prerequisite

Petroleum Technology

Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme

To acquaint the students with natural, nature identical and synthetic perfumery chemicals; structure, synthesis and applications of fragrance chemicals.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Biodiesel and algal fuels: synthesis, properties, applications, economics	15
2	Dimethyl ether, Bioethanol and biobutanol: synthesis, properties, applications, economics	15
3	Non conventional energy: solar, wind, geo thermal energy generation, mechanism, economics	15
4	Tutorials	15
Total		60

Course Outcomes (Students will be able to.....)

CO1	Understand the fundamental knowledge on various energy sources (K2)
CO2	Explaining different derivatization techniques of fuels (K4)
CO3	Apply the fundamental knowledge for various applications of fuels (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; – No Contribution

PCC	Course Code: OLT1129	Course Title: Honors 5: Biobased Materials	Credits = 4		
			L	T	P
	Semester: VI	Total contact hours: 60	2	1	0

List of Prerequisite Courses

Chemistry of Oils, chemistry

List of Courses where this course will be Prerequisite

Application of Oleochemicals in allied industry

Description of relevance of this course in the B. Tech. (Oils, Oleochemicals & Surfactants Technology) Programme

To acquaint the students with natural, nature identical and synthetic perfumery chemicals; structure, synthesis and applications of fragrance chemicals.

Sr. No.	Course Contents (Topics and subtopics)	Required Hours
1	Biobased polymer: derived from vegetable oils, polyols, biopolymers	15
2	Polyurethens: synthesis, properties and applications	15
3	Polyamides: synthesis, properties and applications	15
4	Tutorials	15
Total		60

Course Outcomes (Students will be able to.....)

CO1	Understand the fundamental knowledge on biobased materials (K2)
CO2	Correlating and explaining structure property relationship (K4)
CO3	Apply the fundamental knowledge for various biopolymers (K3)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+Psy	K3	K3+A	K2+A	K3	K6+A+Psy	K3	K4
CO1	K2	3	2	1	2	1	3	3	3	3	3	3	1	3	2
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO3	K3	3	3	2	2	2	3	3	3	3	3	3	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

PCC	Course Code: OLP1209	Course Title: Project – II (Experiments)	Credits = 3		
	Semester: VIII	Total Contact Hours: 90	L	T	P
			0	0	12

List of Prerequisite Courses

Project – I

List of Courses where this course will be prerequisite

Relevant courses in previous courses (Sem. I to Sem. VII)

Description of relevance of this course in the B. Tech. Program

The course is designed to develop skills necessary for executing and solving a unique research problem in Pharmaceutical Sciences and Technology field. After the laboratory work, the findings of the research are presented in a coherent manner, which may result in a patent, publication and/or presentation.

	Course Contents (Topics and Subtopics)	Required Hours
1	The topic of the research with clearly defined Objectives and Hypotheses should be explored systematically, in a scientifically planned rational set of experiments. Students should have actual experimental data collected on the chosen research topic.	60
2	Oral presentation of the proposed research work with data generated during actual laboratory work along with computational studies, if any, targeted towards fulfilling the objectives. The outcome is submitted in the form of a report.	30
	Total	90

List of Textbooks/Reference Books

1 Relevant review articles, research papers, patents, book chapter, books, etc.

Course Outcomes (Students will be able to.....)

CO1	Perform experiments & troubleshoot to generate reliable data (K5)
CO2	Apply different statistical tools for scientific data analysis (K4)
CO3	Evaluate critically the experimental data and draw meaningful inferences (K5)
CO4	Develop skills to communicate the research outcome effectively (K6)
CO5	Develop skills for writing a complete document on the project work (K6)

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+P	K3	K4
CO1	K5	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K4	3	3	2	3	2	3	3	3	2	3	3	2	3	3
CO3	K5	3	3	3	3	3	0	3	3	3	3	3	3	3	3
CO4	K6	3	3	3	3	3	3	1	3	3	3	3	2	3	3
CO5	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

PEC	Course Code: OLT 1218	Course Title: PR9: Triboapplications Laboratory	Credits = 2		
			L	T	P
	Semester: VIII	Total contact hours: 60	0	0	4
List of Prerequisite Courses					
Production and Applications of Soaps, Surfactants and Detergents. Functional Fluids and Performance Chemicals					
List of Courses where this course will be prerequisite					
Project II					
Description of relevance of this course in the B. Tech. Programme					
Students will understand soap, detergent formulations and its evaluation. Luricant testing					
	Course Contents (Topics and subtopics)				Reqd. hours
1	Flash point, Viscosity and viscosity index of lube oil samples				15
2	Pour point, oxidation stability test, Copper corrosion test for lube oil				15
3	Wear scar test for lube oil (4 ball weld load apparatus),				10
4	Extreme pressure test for a lubricant (4 ball weld load apparatus).				10
5	Study experiments on phosphate esters, multifunctional additives and greases.				10
	Total				60
List of Text Books/ Reference Books					
1	Lubricants and Lubrication Edited by Theo Mang and Wilfried Dresel				
2	Lubricants and special fluid by Vaclav stgpina and Vaclav Vesely				
3	Chemistry and Technology of Lubricants Edited by Roy M. Mortier Malcolm F. Fox and				
4	ASTM standards, IP Standards, BIS Standards for testing of petrochemicals				
Course Outcomes (students will be able to					
1	Classify lubricants (K4)				
2	Synthesis of biobased fluids (K4)				
3	Develop lubricant formulation and its analysis (K6)				
4	Summaries the application of functional fluids for various applications (K3)				
5	explain the various testing methods for lubricants (K2)				

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	Psy	K3	Affec	K2+A	K3	A+Psy	K3	K4
CO1	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO2	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO3	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO4	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	3
CO5	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
Course	K4	3	3	2	3	2	3	3	3	3	3	3	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

	Course Code:	Course Title: Internship with Industry	Credits = 12		
			L	T	P
	Semester: VIII	Total Contact Weeks: 12-16	0	0	0
List of Prerequisite Courses					
None					
List of Courses where this course will be prerequisite					
Project – I , Project – II					
Description of relevance of this course in the B. Tech. Program					
The course is designed to –					
1. develop a systematic thinking about an industrial problem;					
2. develop skills for communication, networking, personal grooming & professional conduct within an industrial environment, and					
3. develop the attitude for individual and teamwork.					
	Course Contents (Topics and Subtopics)				Required Weeks
1	Each Student will be involved in R & D/manufacturing (QA/QC/Plant Engineering /Stores and Purchase)/marketing/finance/consultancy/Technical services/ Engineering/Projects, etc., as deemed necessary by the assigned/chosen industry.				12
	Oral presentation & written report of the in-plant training will be evaluated along with industry feedback.				
	Total				12
Course Outcomes (Students will be able to.....)					
CO1	Apply the concept of project & production management in further planning (K3)				
CO2	Develop critical thinking regarding the various operations involved in Oil technology and allied industry (K4)				
CO3	Solve certain industrial challenges in oil technology and allied field (K6)				
CO4	Present and communicate an industrial problem effectively (K6)				
CO5	Write a scientific report on the training (K6)				

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K6	K5	K6	K3	K3+S	K3	K3+A	K2+A	K3	K6+A+S	K3	K4
CO1	K3	3	3	2	2	2	3	3	3	3	3	3	2	3	3
CO2	K4	3	3	2	3	2	3	3	3	3	3	3	2	3	2
CO3	K6	3	3	3	3	3	3	2	3	1	3	2	3	3	3
CO4	K6	3	3	2	3	3	3	3	0	3	3	3	3	2	3
CO5	K6	3	3	3	3	1	3	3	3	3	2	3	3	3	3
Course	K6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge level from cognitive domain; A, Affective domain; P, Psychomotor domain

