Syllabus for Bachelor of Technology

In

OILS OLEOCHEMICALS AND SURFACTANT TECHNOLOGY

(Under the New Education Policy, NEP 2020)

(2023-2024)

Department of OILS OLEOCHEMICALS AND SURFACTANT TECHNOLOGY

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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A. 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 the following Credit Distribution.

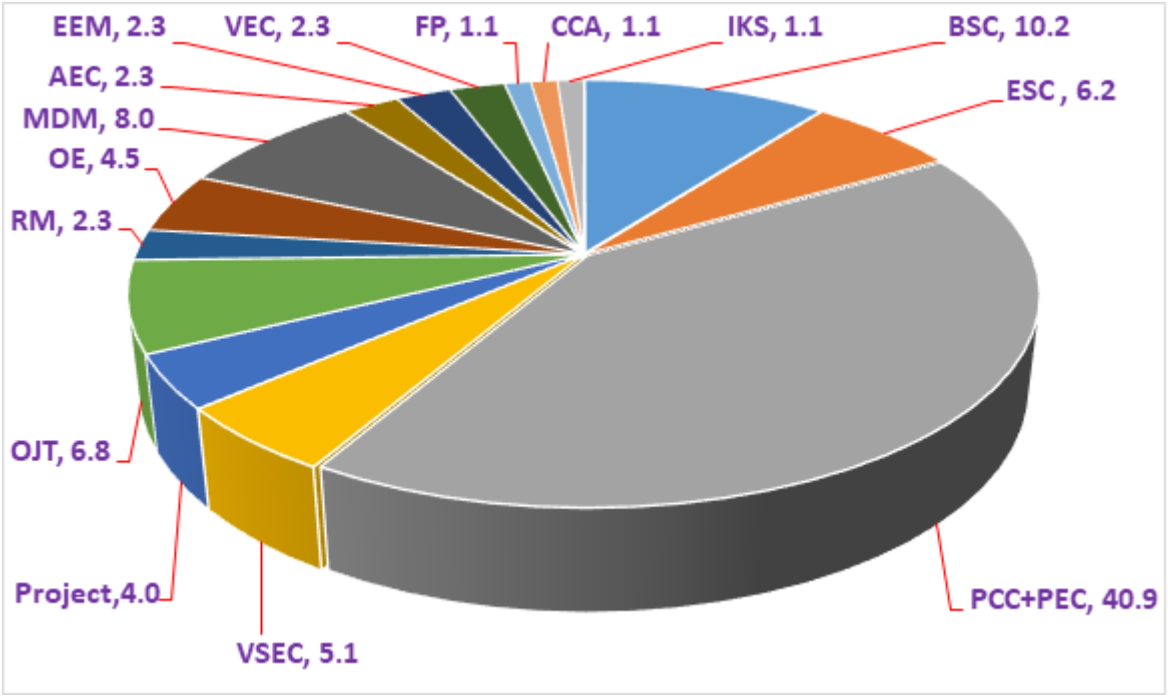

Figure 1 Distribution of various course types (in percentage) for the programme as per the guidelines of NEP 2020. This distribution does not include Honours courses having 18 credits in total.

All the courses are credit based and the evaluations 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. Teachers can have the freedom to interchange lectures / tutorials depending upon the topic. The institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation.

B. Programme Educational Objectives

PEO1	**Successful Career**	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
PEO2	**Higher Study**	Our graduates are expected to attain requisite knowledge and skills to pursue higher education at global level
PEO3	**Multi-disciplinary Skills**	Our graduates are expected to work for designing, implementing and executing various aspects related to oil technologies as well as allied chemical technology
PEO4	**Entrepreneurship**	Our graduates are expected to attain requisite knowledge and skill for entrepreneurship and project management skills

C. Program Outcomes as defined by the National Board of Accreditation (NBA): 12 Graduate Attributes

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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
PO3	**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
PO4	**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.
PO5	**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
PO6	**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.
PO7	**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
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	**Individual and teamwork**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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
PO12	**Life-long learning**	Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

D. Programme Specific Outcomes (PSOs) for B. Tech. (OILS OLEOCHEMICALS AND SURFACTANT TECHNOLOGY)

PSO1	**Understand Oleochemical space**	Able to understand the various theoretical practical aspects related to vegetable oil, oleochemicals and surfactants processing technologies
PSO2	**Analytical Skills**	Able to analyze various physicochemical and performance properties of oils, oleochemicals, surfactants, perfumery chemicals and lubricants based on various applications
PSO3	**Product and Process Development**	Able to gauge the technological, commercial and sustainable requirements of the world and design products and processes accordingly
PSO4	**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.
PSO5	**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.

Exit Policy

As under the NEP –2020 guidelines, the following rules and regulations shall be applicable for the exit from the Degree program where the candidate is currently registered, after the First year, Second Year, and Third Year of the B. Chem. Engg. Degree programs:

a) A candidate who has earned a total of 44 credits after the First year of the Degree Course AND completed eight weeks of practical training can exit the degree course with a Certificate in a relevant degree program.

b) A candidate who has earned a total of 88 credits after the Second year of the Degree Course AND has completed eight weeks of practical training/Internship can exit the degree course with a Diploma in a relevant degree program.

c) A candidate who has earned a total of 132 credits after the Third year of the Degree course AND has completed eight weeks of practical training/ Internship can exit the degree with a B. Sc. degree in a relevant degree program.

d) The candidate shall apply for the exit from the program by this exit policy in a standard format. The letter will be addressed to The Dean, Academic Program. The exit will be permitted only on completion of of the training program as prescribed by the Regulations.

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

Structure of the Syllabus
for
Bachelor of Technology in Oils Oleochemicals and Surfactant Technology
Institute of Chemical Technology, Mumbai

Semester – I										
Subject Code	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
CHT 1405	Physical Chemistry	BSC	3	3	0	0	20	30	50	100
CHP 1406	Analytical Chemistry	BSC	3	3	0	0	20	30	50	100
MAT 1301	Engineering Mathematics		3	3	0	0	20	30	50	100
PYT 1205	Applied Physics	BSC	2	1	1	0	20	30	50	100
GEP1129	Engineering Graphics and Elementary Autocad	VSEC	3	1	0	4	0	30	50	100
OLT1127	SPL1: Introduction to Technology of Oils, Oleochemicals and Surfactants	ESC	2	1	1	0	20	30	50	100
HUT 1110B	Communication Skills	AEC	2	0	0	4	50	0	50	100
	OPEN Activity - Sports/ Fine arts/Yoga/ Music/NSS**	CCA	2	0	0	4	50	0	50	100
PYP 1101	Physics Laboratory	BSC	2	0	0	4	50	0	50	100
	Total		**22**	**9**	**5**	**16**				

Semester – II										
Subject Code	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
CHT1407	Organic Chemistry	BSC	3	2	1	0	20	30	50	100
CHT1408	Industrial Chemistry	BSC	3	2	1	0	20	30	50	100
OLT1131	SPL-2: Nutrition	PCC	2	1	1	0	20	30	50	100
GET1306	Basic Mechanical Engineering	ESC	2	1	1	0	20	30	50	100
GET1125	Electrical Engineering and Electronics	ESC	2	1	1	0	20	30	50	100
CEP1720	Process Calculations	ESC	2	0	0	4	50	0	50	100
CHP1343	Physical and Analytical Chemistry Laboratory	BSC	2	0	0	4	50	0	50	100
CHP1132	Organic Chemistry Laboratory	VSEC	2	1	1	0	30	20	50	100
-	OPEN Activity- Sports/ Fine Arts/Yoga/ Music/NSS**	CCA	2	0	0	4	50	0	50	100
-	MOOC- Indian Knowledge System	IKS	2	0	0	4	50	0	50	100

	(NPTEL - Introduction to Ancient Indian Technology)									
	TOTAL:		**22**	**8**	**6**	**16**				

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	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
OLT1102	SPL-3: Chemistry of Oleochemicals and Surfactant	PCC	4	3	1	0	20	30	50	100
OLT1104	SPL-4 Chemistry of Oils and Fatty Acids	PCC	2	1	1	0	20	30	50	100
-	From Basic Sciences (Chemistry/ Physics/Biology / Maths / Humanities)	OE	4	3	1	0	20	30	50	100
-	Communication Skills – (Marathi / Hindi or Any other language will be chosen using MOOCS)	AEC	2	0	0	4	50	0	50	100
HUT1205	Basic Economics and Finance	EEM	2	1	1	0	20	30	50	100
-	Digital Computation in Emerging Areas **(NPTEL course: Introduction to Industry 4.0 And Industrial Internet Of Things)**	VEC	2	1	1	0	20	30	50	100
-	**MDM-I:** From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	1	1	0	20	30	50	100
OLT1201	Pr 1: Lab-I: Analysis of Oilseeds, Oils and Raw Materials of Oils and Soap Industry	PCC	2	0	0	4	50	0	50	100
OLP1217	Pr 2: Lab 2: Preparation and Purification of Organic Derivatives	PCC	2	0	0	4	50	0	50	100
	Total		**22**	**10**	**6**	**12**				

Semester – IV

Subject Code	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
CET1105	Transport Phenomena	PCC	4	3	1	0	20	30	50	100
OLT1111	SPL-5: Nutraceuticals	PCC	3	2	1	0	20	30	50	100
OLT1108	SPL-6: Technology of Perfumery Chemicals	PCC	3	2	1	0	20	30	50	100
-	From Basic Sciences (Chemistry/ Physics/ Biology / Maths) or Humanities Discipline	OE	2	1	1	0	20	30	50	100
CET1805	Chemical Process Economics	EEM	2	1	1	0	20	30	50	100
HUT1206	Environmental Sciences and Technology	VEC	2	1	1	0	20	30	50	100
-	**MDM II:** From Sciences and/or any other Engineering /Humanities	MDM	2	1	1	0	20	30	50	100
-	Community Projects #	CEP/FP	2	0	0	4	-	50	50	100
OLP1204	Pr3: Lab-3:Analysis of Surfactants	VSEC	2	0	0	4	-	50	50	100
	Total		**22**	**11**	**7**	**8**				

Note: # 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	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
CET1806	Chemical Reaction Engineering	PCC	2	1	1	0	CA	MS	ES	Total
CET1807	Chemical Engineering Operations	PCC	2	1	1	0	20	30	50	100
OLT1105	SPL-7: Technology of Oil & Fat Production And Edible Oil Processing	PCC	4	3	1	0	20	30	50	100
-	Offered by the department/MOOCs	PEC	4	3	1	0	20	30	50	100
-	From Basic Sciences (Chemistry/ Physics/ Biology / Maths) or Humanities Discipline	OE	2	1	1	0	20	30	50	100
OLT1114	Honors Course -I: Byproducts Utlization and Waste Management (Subject code : OLT1114)	PCC	4	3	1	0	20	30	50	100
-	**MDM III:** From Sciences and/or any	MDM	4	2	0	4	20	30	50	100

	other Engineering / Humanities Discipline									
OLP1212	Pr5: Lab-4:Essential Oil Laboratory	PCC	2	0	0	4	20	30	50	100
OLP1204	Pr4: Lab-5 : Evaluation and Testing of Soaps and Detergents	PCC	2	0	0	4	-	50	50	100
	TOTAL:		**26**	**14**	**6**	**12**	-	50	50	100

Semester – VI										
Subject Code	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
OLT1107	SPL-9: Cosmetics Science	PCC	3	2	1	0	CA	MS	ES	Total
OLT1106	SPL-10: Production and Applications of Soaps, Surfactants and Detergents	PCC	3	2	1	0	20	30	50	100
-	Offered by the department/MOOCs	PEC	4	3	1	0	20	30	50	100
OLT 1110	SPL-12: Technology of Drying Oils and Resins	PCC	4	3	1	0	20	30	50	100
OLT1126	Honors Course-II: Modern Analytical Techniques	PCC	4	3	1	0	20	30	50	100
-	**MDM IV:** From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	1	1	0	20	30	50	100
CEP1714	Chemical Engineering Laboratory	VSEC	2	0	0	4	20	30	50	100
OLP1202	Pr6: Lab -6: : Processing of Oleochemicals& Waxes and Cosmetics Formulations	PCC	2	0	0	4	-	50	50	100
	Offered by the department/MOOCs	PEC	2	0	0	4	-	50	50	100
	TOTAL:		**26**	**14**	**6**	**12**	-	50	50	100

Semester – VII										
Subject Code	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
OLT1115	SPL-13: Petroleum Technology	PCC	3	2	1	0	20	30	50	100
OLP1112	SPL-14: Technology of Oleochemicals	PCC	2	1	1	0	20	30	50	100
	Offered by the department/MOOCS	PEC	3	2	1	0	20	30	50	100

	Offered by the department/MOOCS	PEC	2	2	0	0	20	30	50	100
OLT1127	Honors-III: Optimization Techniques	PCC	4				20	30	50	100
	MDM V: From Sciences and/or any other Engineering/ Humanities Discipline	MDM	2	1	1	0	20	30	50	100
OLT1130	Literature Review (Research Methodology - I)	RM-1	2	1	0	2	20	30	50	100
OLP1219	Design and Analysis of Experiments (Research Methodology - II)	RM-2	2	1	0	2	20	30	50	100
OLP1216	Project -I (Literature search + Expt)	Project	4	0	0	8	-	50	50	100
OLP1210	Pr8: Processing of Soaps, Detergents & Surfactants	PCC	2	0	0	4	-	50	50	100
	Total									

Semester – VIII (10 Weeks)										
Subject Code	Subject	Course Type	Credits	Hrs/Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
OLT1113	SPL-15: Functional Fluids and Performance Chemicals	PCC	3	5	1	0	20	30	50	100
OLT1128	Honors Course-IV: Alternative Fuels and Energy	PCC	3	5	1	0	20	30	50	100
OLT1129	Honors Course-V: Biobased Materials	PCC	3	5	1	0	20	30	50	100
-	**MDM VI:** From Sciences and/or any other Engineering / Humanities Discipline	MDM	2	2	1	0	20	30	50	100
OLP1209	Project-II (Experiments)	PCC	3	0	0	12				
-	Offered by the department/MOOCs	PEC	2	0	0	6	-	50	50	100
Semester – VIII (12-16 Weeks)										
FDP 1042	Internship with Industry	OJT	12	0	0	0				
	Total	**28**	**17**	**4**	**18**	**28**				
	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, Food Engineering & Technology 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 Food Engineering & Technology 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

E. Detailed Syllabus

Semester-I

BSC	Course Code: CHT1405	Course Title: Physical 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 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 Chaterlier'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; 11th 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	Understand the concepts of thermodynamics and relate them to measurable quantities	K2
CO2	Elucidate the effect of thermodynamic quantities on physical and chemical equilibria	K4
CO3	Correlate the thermodynamic properties of chemical systems with the observed outcomes and predict the optimum conditions	K3
CO4	Comprehend fundamental knowledge in chemical kinetics with basics of order, molecularity and temperature effect	K2
CO5	Examine kinetics for complex, fast and interfacial reactions	K3
CO6	Comprehend different theories in kinetics to explain the molecular origin of kinetic phenomena	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	2	1	2	0	0	1	0	2
CO2	2	3	2	3	2	2	2	1	1	1	1	1
CO3	2	3	2	3	2	2	2	1	1	1	1	1
CO4	2	3	1	2	2	1	2	0	0	1	0	2
CO5	3	3	2	3	2	2	2	1	0	1	0	1
CO6	2	2	3	3	2	1	1	1	0	1	1	1

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	0
CO2	1	2	1	0	0
CO3	2	2	1	0	0
CO4	1	2	1	0	0
CO5	2	1	2	0	0
CO6	2	1	1	1	1

BSC	Course Code: CHT 1406	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(CHP1343),

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.

	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, 7th ed.; Wadsworth Publishing, USA (2004)
4	D. A. Skoog, D. M. West, F. James Holler and S. R. Crouch. Fundamentals of Analytical Chemistry; 9th ed.; Cengage Learning (2013)
5	D. A. Skoog, F. James Holler and S. R. Crouch. Principles of Instrumental Analysis; 6th ed.; Cengage Learning (2016)

Course Outcomes (students will be able to….)

CO1	Explain the principles of UV-visible and fluorescence spectroscopic methods	K3
CO2	Explain the principles of electrochemical methods	K3
CO3	Understand the principles of chromatographic separations	K3
CO4	Evaluate the results of chemical analysis in terms of accuracy and precision	K4
CO5	Apply the principles of sampling to design an optimum analytical protocol	K4
CO6	Identify conditions to minimize the error and increase the sensitivity of analysis	K5

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	2	1	1	0	1
CO2	2	3	2	3	3	2	2	1	1	1	0	1
CO3	2	3	2	3	3	2	2	0	1	1	0	1
CO4	2	3	2	3	3	2	2	1	1	1	0	1
CO5	2	2	2	1	2	1	1	1	0	1	1	0
CO6	2	2	1	1	2	1	2	1	0	0	0	0

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	1	0	0
CO2	1	2	1	0	0
CO3	1	2	1	0	0
CO4	1	2	1	0	0
CO5	1	2	1	2	1
CO6	1	2	1	1	1

	Course Code: MAT 1301	Course Title: Engineering Mathematics	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 60	3	0	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

This is a basic Mathematics course which will give the students the required foundations of mathematics to understand engineering concepts in the later part of the technology programs in ICT Mumbai. This course will also introduce probability distributions and basic statistics will be helpful to understand various data science studies in different engineering disciplines.

	Course Contents (Topics and subtopics)	Required Hours
1	**Linear Algebra:** Vectors in $\mathbb{R}^n$, notion of linear independence and dependence. $\mathbb{R}^n$ as a vector space, 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. 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 square methods, Diagonalization of matrices and its applications to stochastic matrices	15
2	**Differential Calculus:** Higher order differentiation and Leibnitz Rule for the derivative, Taylor's and Maclaurin's theorems, Maxima/Minima, convexity of functions and applications. 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, Method of Lagrange Multipliers, Introduction to double and triple integrals.	15
3	**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	15
	Total	**45**

List of Textbooks/ Reference Books

1	G. Strang, Linear Algebra and its Applications (4th Edition), Thomson (2006).
2	Howard Anton, Elementary Linear Algebra, John Wiley & Sons (2016)
3	Stewart, James, Single Variable Calculus, 6th Edition, Cenage learning (2016)
4	Hughes-Hallett et al., Calculus - Single and Multivariable (3rd Edition), John-Wiley and Sons (2003).
5	E. Kreyszig, Advanced Engineering Mathematics (8th Edition), John Wiley (1999). (Officially prescribed)
6	S. R. K. Iyengar, R. K. Jain, Advanced Engineering Mathematics Narosa, (2020)
7	A First Course in Probability, Sheldon Ross, Pearson Prentice Hall, 9th Edition (2018)
8	W.W. Hines, D. C. Montgomery, D.M. Goldsman, John-Wiely, Probability and Statistics in Engineering, John Wiley & Sons (2008)

9	Alexander M. Mood, Duane C. Boes, and Franklin A. Graybill, Introduction to the Theory of Statistics, Mc GrawHill, (1973)

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	Understand the notion of integrability and be able to compute multiple integrals and apply them in engineering applications.	K3
CO3	Understand the computational and geometrical concepts related to linear transformations, eigenvalues and eigenvectors and apply them to solve computational problems	K3
CO4	Demonstrate understanding of different concepts in linear algebra in solving computational problems related to vectors and matrices and apply them to solve problems arising the Engineering especially in AI and ML.	K4
CO5	Understand the concepts of various probability distributions and apply them to analyze various engineering problems and make inference about the system	K3
CO6	Understand the method of linear and nonlinear least squares method and apply it to choose appropriate mathematical functions for modelling real data sets, arising from engineering disciplines	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	0	0	0	0	0	0	3
CO2	2	2	1	1	1	0	0	0	0	0	0	3
CO3	2	2	1	1	1	0	0	0	0	0	0	3
CO4	2	2	1	1	2	0	0	0	0	1	0	3
CO5	2	2	1	1	1	0	0	0	0	0	0	3
CO6	2	3	3	1	2	1	0	0	3	1	0	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	1	1	0	0
CO2	0	1	1	0	0
CO3	0	1	1	0	0
CO4	0	1	1	0	0
CO5	0	1	1	0	0
CO6	2	1	1	2	0

	Course Code: PYT 1205	Course Title: Applied Physics	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 30	2	0	0

List of Prerequisite Courses	
Standard XI and XII Physics course, Standard XII Chemistry course	

List of Courses where this course will be a prerequisite
NIL

Description of the relevance of this course in the B. Tech. Program
Materials and their properties play a key role in chemical engineering and technology. The Applied Physics course will provide the students with the necessary fundamentals to develop a broad understanding of various aspects related to materials, thereby equipping them with the ability to apply it wherever required in their course of study.

	Course Contents (Topics and subtopics)	Hours
	Crystal Structure of Solids: A revision of concepts of a lattice, a basis, a unit cell, different crystal systems (SC, BCC, FCC, HCP), co-ordination numbers and packing fractions. Single crystalline, Polycrystalline, and Amorphous materials.	3
	Crystallographic planes and directions: concept of Miller indices and its determination, examples; calculation of inter-planar spacing in terms of Miller indices.	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
	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
	Physics of Fluids	
	A revision of the basic concepts of hydrostatics and ideal fluid flow: Equation of continuity and Bernoulli's equation.	4
	The concept of viscosity, Newton's law of viscosity, Reynold's number, Poiseuille's equation for streamline flows	4
	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 - 6th Edition - John Wiley
2	Sears and Zeemansky's University Physics - Young and Freedman - 12th Edition - Pearson Education
3	A Textbook of Engineering Physics - M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy - 11th Edition - S. Chand Publishers
4	Solid State Physics - S. O. Pillai - 10th Edition - New Age Publishers

5	Solid State Physics - A. J. Dekker - MacMillan India
6	Engineering Physics - V Rajendran - 6th Edition - McGraw Hill Publishers
7	Introduction to Rheology – H. A. Barnes, J. F. Hutton and K. Walters – 4th Edition – Elsevier Science.
8	Viscoelastic Properties of Polymers – J. D. Ferry – 3 rd Edition – Wiley

Course Outcomes (students will be able to….)		
CO1	Assign Miller indices to various crystallographic planes and directions in a crystal lattice, thereby understanding periodicity in the crystal lattice.	K4
CO2	Analyze a given x-ray diffraction pattern to deduce the material's crystal structure and calculate the values of the basic structural parameters.	K4
CO3	Classify solids, and in turn semiconductors, based on electron occupancy and calculate basic quantities related to charge transport in them.	K3
CO4	Analyze simple ideal fluid flows by applying the continuity equation and Bernoulli's equation	K3
CO5	Describe the basic behavior of viscous flows and the relationships between various flow parameters.	K4
CO6	Understand simple models that are used to describe viscoelastic flows.	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	1	1	1	1	1	1	3
CO2	3	3	3	2	2	1	1	1	1	1	1	3
CO3	3	3	2	2	2	2	1	1	1	1	1	3
CO4	3	2	3	3	2	1	1	1	1	1	1	3
CO5	2	2	2	3	2	1	1	2	1	1	1	3
CO6	2	2	3	2	2	1	1	1	1	1	1	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	1	0
CO2	1	2	1	0	0
CO3	1	2	2	0	0
CO4	1	2	3	2	2
CO5	2	3	3	2	2
CO6	1	2	2	1	0

VSEC	Course Code: GEP1129	Course Title: Engineering Drawing and Computer Aided Drafting	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 75	1	0	4

List of Prerequisite Courses

Standard XII Mathematics

List of Courses where this course will be prerequisite

Professional Career (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.	15 (3L+12P)
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 (3L+12P)
3	**Isometric projections:** Concept of isometric views, isometric projections and isometric scale, Iso metric projections of different solids and machine components.	10 (2L+8P)
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.	10(2L+8P)
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.	25(5L+20P)
	Total	**75(15L+60P)**

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 Projections of Solid objects.	K4
CO2	Draw Third view of solid object when two views are given	K4
CO3	Draw isometric Projections of Solid objects.	K4

CO4	Draw assembly of various machine components	K4
CO5	Understand basic commands of CAD software	K2
CO6	Use CAD software for drafting and editing 2 dimensional drawings	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	0	0	0	0	0	0	0	1	0	0	0
CO2	3	0	0	0	0	0	0	0	1	0	0	0
CO3	3	0	0	0	0	0	0	0	1	0	0	0
CO4	3	0	0	0	0	0	0	0	1	0	0	0
CO5	3	0	0	0	3	0	0	0	2	0	0	3
CO6	3	0	0	0	3	0	0	0	2	0	0	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	0	1	1	2
CO2	0	1	1	1	2
CO3	0	1	1	1	1
CO4	0	0	1	1	1
CO5	1	0	1	1	0
CO6	2	0	1	1	0

BSC	**Course Code:** OLT 1127	**Course Title:** Introduction to Technology of Oils, Oleochemicals and Surfactants	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours:** 30	**2**	**0**	**0**

List of Prerequisite Courses	
1	Standard XII Chemistry course
List of Courses where this course will be prerequisite	
1	Chemistry of Oils and Fatty Acids (Sem-III)
2	Chemistry of Oleochemicals and Surfactants (Sem-III, IV, V, VI, VII, VIII)
Description of relevance of this course in the B. Chem. Tech. Program	
Oils and fats are key molecules in the various industrial applications. The course will provide the students with the necessary fundamentals to develop a broad understanding of industrial applications related to oils, oleochemicals and surfactants and thereby equip them with the ability to apply it wherever required in their course of study.	

	Course Contents (Topics and subtopics)	**Reqd. hours**
	Solid State Physics	
1	Basic chemistry of vegetable oils, structure, industrial application	8
2	Fatty acids: Structure, properties, applications	8
3	Oleochemicals: market dynamics, applications	7
4	Surfactants: role of surfactants in various applciations	7
	Total	**30**

List of Textbooks/Reference books	
1	Industrial Oils and Fats by A. E, Bailey, Vol. I to Vo. VI, (2005) John Wiley & Sons
2	Oils and Fats Manual: A Comprehensive Treatise - Properties, Production, Applications, (1996), Intercept Ltd.

Course Outcomes (students will be able to….)		
CO1	Apply the knowledge on oils and fats for industrial Processes.	K3
CO2	Apply structure property relationship	K3
CO3	Introduced to the principles of manufacturing and applications.	K2,
CO4	Calculate theoretical values of basic analytical properties	K3
CO5	Describe principles of market dynamics	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	2	2	1	3	3	1	2
CO2	3	2	2	1	2	2	3	2	3	3	0	2
CO3	3	2	3	2	2	2	2	1	3	2	2	2
CO4	2	3	3	2	2	2	1	2	2	3	3	2
CO5	2	2	2	2	1	1	2	3	1	3	2	1

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	2
CO2	3	2	2	1	2

CO3	1	1	3	3	3
CO4	2	3	3	2	2
CO5	2	2	3	2	3

AEC	Course Code: HUP1110B	Course Title: Communication Skills (English)	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 60	0	0	4

List of Prerequisite Courses
Standard XIIth 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.

	Course Contents (Topics and subtopics)	Required Hours
1	Communication as a way of life Process of communication and its elements Functions of communication and importance in future careers Essentials of good communication	6
2	The communication cycle The 5 steps communication cycle: Idea formation Message encoding Message transmission Decoding Feedback	4
3	Factors affecting effective communication Planning for effective communication Modes of communication	3
4	Non verbal communication Gestures Facial expressions Posture and movement Paralinguistics Eye contact Image management	4
5	Presentation skills What makes good presentation Prsenting the message Presenting oneself Visual Communication	8
6	Introduction to research study Introduction to databases Introduction to citation and referencing styles How to conduct literature review Preparation of a report based on literature review	5
	Total	**60**

List of Textbooks/ Reference Books	
1	Elements of Style – Strunk and White

Course Outcomes (students will be able to….)		
CO1	Student would be able to illustrate the 5 step communication process	K2+P2
CO2	Student would be able to explain the end goal of communication	K2+P2
CO3	Student would be able to explain barriers to clear communication	K2+P2

CO4	Student would be able to articulate the role of visual communication within society, and implement the creative process to express himself/herself.	K2+P2
CO5	Student would be able to identify the most relevant textbooks, reviews, papers and journals	K2+P2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating P1 – Imitate, P2 – Manipulate, P3 – Perfect, P4 – Articulate, P5 – Embody		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	0	0	0	0	0	1	1	2	2	2	2
CO2	0	0	0	0	0	0	1	1	2	2	2	2
CO3	0	0	0	0	0	0	1	1	2	2	2	2
CO4	0	0	0	0	0	0	1	1	2	2	2	2
CO5	0	0	0	0	0	0	1	1	2	2	2	2

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	1	1	0	0
CO2	0	1	1	0	1
CO3	0	1	1	0	1
CO4	0	1	1	0	1
CO5	0	1	1	0	1

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	1	2	2
CO2	1	2	2	1	3
CO3	0	1	1	0	1
CO4	0	1	1	0	1
CO5	0	1	1	0	1

<table>
<tr><td rowspan="2">CCA</td><td>Course Code: XXXXXXX</td><td colspan="2">Course Title: Yoga and Self Development</td><td colspan="3">Credits= 2</td></tr>
<tr><td></td><td colspan="2"></td><td>L</td><td>T</td><td>P</td></tr>
<tr><td></td><td>Semester: I</td><td colspan="2">Total contact hours: 60</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="7">Prerequisites</td></tr>
<tr><td colspan="7">It may be necessary to gather some basic information about the students, such as their age, marital status, academic schedules, and recreational activities, whether they have any sleep issues and stress because of any situation. It shall be better to know how the students deal with stress, and whether they have proper nutrition. We also might need information about any injuries past or current and any other medical condition that may interfere in the program.</td></tr>
<tr><td colspan="7">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="7">Applicable throughout professional and personal lives</td></tr>
<tr><td colspan="7">Description of relevance of this course in the B. Tech. Program</td></tr>
<tr><td colspan="7">Yoga is not course but a journey. The benefits of Yoga are many. It brings in calmness of mind besides the physical fitness by doing Yoga Aasanas. Apart from flexibility developed by regular physical activities, it makes one aware of his own potential. Professional and personal lives are full of situations that can be stressful. Yoga helps the students to withstand the stress coming from the expectations and demands of their own lives.</td></tr>
<tr><td>Sr. No</td><td colspan="4">Course Contents (Topics and subtopics)</td><td colspan="2">Reqd. hours</td></tr>
<tr><td>1</td><td colspan="4">Yoga
The principles and foundations of yoga. Both concentrative and insight meditation techniques may be practiced for each session. Behavioural techniques of self-monitoring should also be practiced observing the stream of consciousness from the perspective of a vigilant but detached observer.
The students shall be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioural relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta-cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences. The students may learn to turn-off or bypass the cognitive processing of usual daily preoccupations and concerns, allowing access to mindful, spiritual and meditative state of self-realization
The students shall keep a small journal to write down their own journey/progress on physical flexibility, strength building and most importantly, how they deal with stressful conditions. This record will form the paper assessment of the student.
Yoga helps to develop many mental skills like mindfulness, self-control, focus, and even self-compassion. It’s mainly a physical practice. The students are taken through different movements and poses during the yoga sessions.</td><td colspan="2">40</td></tr>
<tr><td>2</td><td colspan="4">Assessment: The following assessments are recommended:
Regular attendance
Paper Assessment: A paper assessment may include assessing student’s understanding of the basic philosophy of yoga
Verbal Assessment on the basis of his/her ability to assimilate the philosophy of yoga and practicing in daily life.
Mobility & Flexibility assessment is to assess the strength and flexibility, like twist.</td><td colspan="2">20</td></tr>
<tr><td></td><td colspan="4">List of Books</td><td colspan="2"></td></tr>
</table>

1	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata	
2	RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016	
Course Outcomes (students will be able to…..)		
CO1	Keep physically fit and mentally agile	K2
CO2	Manage stress in studies and later in life	K2
CO3	Coordinate body and mind together	K2
CO4	Understand own emotions and maintain healthy daily routine	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	1	2	0	1	0	1	2	2	1	0	1
CO2	0	1	1	0	1	0	1	2	1	1	0	1
CO3	0	1	2	0	1	0	1	2	2	1	0	1
CO4	0	1	2	0	1	0	1	2	2	1	0	1

Course Code:	**Course Title: Fine Arts and Performing Arts**	**Credits = 2**		
		L	**T**	**P**
Semester: I	**Total contact hours: 30**	**2**	**0**	**0**
List of Prerequisite Courses				
NA				
List of Courses where this course will be prerequisite				
NA				
Description of relevance of this course in the B. Tech. Program				
Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations				

Sr. No	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	The Institute offers a range of courses in different art forms: music, dance, theatre, painting, and other art forms. Students will be given an option to choose a particular art form, and learn and practice it under an artist-instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form.	30
	Total	**30**

Course Outcomes (students will be able to…..)		
CO1	Enhance perceptual and cognitive skills	K3
CO2	Develop self-esteem, motivation, aesthetic awareness, cultural exposure	K2
CO3	Be creative with improved emotional expression	K4
CO4	Develop social harmony and appreciation of diversity.	K2

CO5	Develop an understanding and sharing of culture, with social skills that enhance the awareness and respect of others	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

	Course Code: PYP 1101	Course Title: Applied Physics Laboratory	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 60	0	0	4

List of Prerequisite Courses		
Standard XI and XII Physics course, Applied Physics (theory)		
List of Courses where this course will be a prerequisite		
Nil		
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 specializations.		
Course Contents (List of Experiments)		
1	Determination of Co-efficient of Viscosity by Poiseuille's method	04
2	Thermistor characteristics: Determination of Bandgap of a semiconductor	04
3	Determination of compressibility of liquids using an Ultrasonic Interferometer	04
4	Measurement of thermal conductivity of a solid: Lee's disc method	04
5	Photoelectric effect: Determination of h/e	04
6	Hall effect-I (sample current variation) Determination of carrier type and concentration in a semiconductor	04
7	Hall effect-II (magnetic field variation) Determination of carrier type and concentration in a semiconductor	04
8	Newton's rings: Determination of wavelength of light	04
9	Laser Diffraction: Determination of particle size	04
10	Studying variation of compressibility of liquid as function of temperature	04
11	Estimating resistivity of semiconductor using four probe metho	04
12	Determination of magnetic susceptibility of paramagnetic liquid using Quincke's method	04
List of Textbooks / Reference Books		
1	Fundamentals of Physics - Halliday, Resnick, Walker - 6th Edition - John Wiley	
2	Sears and Zeemansky's University Physics - Young and Freedman - Pearson Education	
3	Engineering Physics - V Rajendran - 6th Edition - McGraw Hill Publishers	
4	Fundamentals of Optics - F. Jenkins and H. White - 4th Edition McGraw Hill	
5	ICT Physics Laboratory Manual (supplied to students)	
Course Outcomes (students will be able to….)		
CO1	Independently set up, handle, and use basic setups to measure and obtain various physical quantities.	K4
CO2	Use basic instruments like vernier-caliper, screw-gauge, travelling microscope, thermometer, etc. to make accurate measurements.	K4
CO3	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.	K3

CO4	Preliminarily treat the obtained datasets statistically to obtain errors in the experiments.	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	1	2
CO2	0	2	1	2	1
CO3	2	3	2	1	1
CO4	0	2	2	1	1

Semester-II

BSC	Course Code: CHT1407	Course Title: Organic Chemistry	Credits = 3		
			L	T	P
	Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Std XII Chemistry

List of Courses where this course will be Prerequisite

Organic Chemistry, Biochemistry and several Special Subjects involving Oleochemical synthesis of Oils Oleochemical and surfactant Technology Departments

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

This course is designed to acquaint the students with fundamentals of Organic Chemistry – including nomenclature of organic compounds, types of reactions, reaction mechanisms, organic transformations, selectivity of chemical transformations, etc. Stereochemical outcome of organic reactions and the practical implications of stereoselectivity will also be discussed.

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 Textbooks/Reference Books

1	Clayden, J., Greeves, N., Warren, S.; Organic Chemsitry; 2nd ed.; Oxford University Press (2012)
2	Graham Solomons, T. W.; Fryhle, Craig B.; Snyder, Scott A. Organic Chemistry; 12th Ed.; John Wiley & Sons. Inc. (2016)
3	Smith, M. B.; March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure; 7th ed.; Wiley, India (2015)
4	Carey F. A., Sundberg, R. J. Advanced Organic Chemistry: Part A: Structure and Mechanisms; 5th ed.; Springer (2005)
5	Carey F. A., Sundberg, R. J.; Advanced Organic Chemistry: Part B: Reaction and Synthesis; 5th ed.; Springer (2007)
6	Wade, L. G.; Simek, J. W.; Singh, M. S. Organic Chemistry; 9th ed.; Pearson Education (2019)

7	Eliel, E. L. Stereochemistry of Carbon Compounds; Mcgraw-Hill (2001)
8	Bruice, Paula, Y. Organic Chemistry; 8th 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	Understand principles of 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	K4
CO5	Appreciate the stereo-chemical implications of organic compounds and visualize and appreciate the chirality concept	K4
CO6	Understand organic chemistry reactions related to aliphatic as well as aromatic compounds as well as decipher the outcome of a given organic transformation	K4
CO7	Interpret and analyze reactions having different functionalities, deduce and solve problems related to the reactions as well as apply them	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Organic Chemistry – CHT1407

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	1	0	2	1	0	2	0	2
CO2	2	2	2	2	2	1	3	1	1	1	0	2
CO3	1	2	2	1	1	1	3	2	0	1	1	2
CO4	3	3	2	3	2	1	2	1	0	2	1	1
CO5	2	3	3	1	2	1	3	1	0	1	0	1
CO6	2	3	2	1	1	2	2	0	1	1	0	1
CO7	2	3	3	3	2	2	2	2	1	1	1	1

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	0	2	2
CO2	1	2	1	1	1
CO3	2	2	1	1	1
CO4	3	2	1	1	1
CO5	1	1	1	1	0
CO6	2	2	2	1	0
CO7	1	1	1	0	0

BSC	Course Code: CHT1408	Course Title: Industrial Chemistry	Credits = 3		
			L	T	P
	Semester: II	Total Contact Hours: 45	2	1	0

List of Prerequisite Courses

Standard XII Inorganic Chemistry

List of Courses where this course will be Prerequisite

Technology of Oil & Fat Production And Edible Oil Processing, Chemical Reaction Engineering

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

It is important for engineering graduates to be familiar with the industrial scale-up of basic organic and inorganic reactions. The course aims to acquaint the students with synthesis, properties and applications of various industrial inorganic chemicals of commercial importance. The economic and ecological factors to be considered while selection and execution of such processes will also be discussed.

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, 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, 2008, Wiley-VCH.
3	Inorganic Chemistry – an industrial and environmental perspective, T.W. Swaddle, ISBN 0-12- 678550-3, 482 pages, Academic Press, 1997

Course Outcomes (students will be able to….)

CO1	Understand the important chemical principles applied to various industrial processes	K2
CO2	Describe the fundamental processes underlying manufacture of important organic chemicals	K2
CO3	Describe the fundamental processes underlying manufacture of important inorganic chemicals	K2
CO4	Review and assess the impact of the chemical factors on the efficiency of industries and feedstock manufacturing	K3

CO5	Modify existing applications for improving the efficiencies in terms of yields, energy requirement and environmental impact	K4
CO6	Evaluate the modifications in terms of long-term environmental implications	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	1	3	1	1	3	0	2
CO2	3	2	3	2	2	2	3	1	2	2	1	2
CO3	3	3	3	2	1	2	3	2	2	2	2	2
CO4	3	3	3	2	1	3	3	2	2	2	2	2
CO5	2	1	3	1	1	2	2	1	1	1	0	0
CO6	2	2	1	1	1	1	2	1	1	1	0	0

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	1
CO2	2	2	3	3	1
CO3	1	2	2	1	1
CO4	3	2	3	2	1
CO5	1	2	2	1	1
CO6	2	2	2	2	2

PCC	Course Code: OLT 1103	Course Title: SPL2:NUTRITION	Credits = 2		
			L	T	P
	Semester: II	Total contact hours: 30	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 ,Neutraceutics	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)	K2
CO 2	Identify major food constituents like Carbohydrates, lipids and Proteins. (K3)	K3
CO 3	Proximate analysis of foods, Computation of daily calorie requirements, Nondigestible carbohydrates, Dietary Fibre, Glycemic properties etc. (K4)	K4
CO 4	Analyse protein quality, Antinutritional factors, vitamins and minerals etc. (K4)	K4
CO 5	Ability to identify role of nutrients and ABCDs of nutritional assessment. (K3)	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	1	0	1	2	3	3	3	3	3	1
CO2	2	1	2	1	2	3	3	3	3	3	3	3
CO3	1	0	0	1	2	2	3	3	3	3	3	3
CO4	1	1	2	0	2	3	3	3	3	3	3	2
CO5	1	0	1	1	2	2	2	3	3	2	2	2

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	1	0
CO2	2	1	2	1	0
CO3	1	0	1	1	0
CO4	1	0	1	1	0
CO5	1	0	1	1	1

ESC	Course Code: GET1306	Course Title: Basic Mechanical Engineering	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 30	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 Saravanamutoo

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

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	1	0	2	1	3	1	3	3	3	3	1
CO3	3	3	2	2	2	3	3	3	3	2	3	2
CO4	3	2	1	2	0	3	3	2	3	3	3	1
CO5	3	2	1	2	0	3	3	2	3	3	3	1
CO6	3	2	1	2	0	3	3	2	3	3	3	1

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	1	1	1	1
CO2	0	1	1	1	0
CO3	1	1	1	1	0
CO4	0	0	0	1	0
CO5	0	1	1	1	0
CO6	2	2	2	2	1

ESC	Course Code: GET1125	Course Title: Electrical Engineering and Electronics	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 30	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 Boylstead, 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. supply and circuits, Solve basic electrical circuit problems	K3
CO2	Understand the basic concepts single phase and three phase AC supply and circuits, Solve basic electrical circuit problems	K3
CO3	Understand the basic concepts of transformers, evaluate, and calculate efficiency at various load condition.	K5
CO4	Understand the concept of motors and their uses as various industrial drives.	K5
CO5	Understand the basic concepts of electronic devices and their applications in power supplies, amplification and instrumentation	K4
CO6	Understand the basic concepts of operational amplifiers and their applications, Understand the concept of Data acquisition, signal conditioning	K4

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	0	0	0	0	2	3	2	0	0
CO2	3	3	0	0	0	0	0	2	3	2	0	0
CO3	3	3	0	0	0	0	0	2	3	2	0	0
CO4	3	3	0	0	0	0	0	2	3	2	0	0
CO5	3	3	0	0	0	0	0	2	3	2	0	0
CO6	3	3	0	0	0	0	0	2	3	2	0	0

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	1	2	1	1
CO2	0	0	1	1	0
CO3	1	1	1	1	0
CO4	2	1	2	1	0
CO5	2	1	2	0	0
CO6	2	1	2	0	0

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		
	XIIth 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….)		
CO1	Students should be able to calculate friction factor, pressure drop, power requirements of singe phase flow in a circular pipe	K2
CO2	Students will be able to select appropriate pump based on flow and head requirements	K3
CO3	Students should be able to calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers	K3
CO4	Students should be able to perform preliminary sizing of phase change equipment such as reboilers and condensers	K3

CO5	Students should be able to calculate mass transfer coefficients and estimate mass transfer rates in simple situations	K3
CO6	Students should be able to understand empirical correlations and solve various equations analytically or numerically	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	1	1	1	3
CO2	3	3	2	3	2	1	2	1	1	1	1	3
CO3	3	3	3	3	3	1	2	2	2	1	1	3
CO4	3	3	3	3	3	1	1	1	2	1	1	3
CO5	3	3	2	3	2	1	1	1	1	1	1	3
CO6	3	3	2	3	3	1	1	1	1	1	1	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	1
CO2	2	3	3	2	1
CO3	3	3	2	3	3
CO4	3	3	2	3	3
CO5	3	2	1	3	2
CO6	2	2	1	2	2

BSC	Course Code: CHP1343	Course Title: Physical and Analytical Chemistry Laboratory	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses

List of Courses where this course will be prerequisite

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

The laboratory course is mainly focused on imparting critical experimental skills in Physical and Analytical Chemistry to the undergraduate students. It is expected that they will not only become familiar with laboratory experimental skills but also planning of experiments and interpretation of experimental tasks. The course will help them to understand the relevance of chemical principles in real-life applications.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	The experiments will focus on the following key concepts / skills: **Physical Chemistry:** • determination of dissociation constants of a polybasic acid • determination of critical micelle concentration (CMC) of the given surfactant • study of kinetics of reaction – order of reaction, activation energy • study of weak and strong electrolytes • characterization of polymers using MW / viscosity determination **Analytical Chemistry:** • determination of water quality (hardness / BOD / COD) • determination of composition in a mixture of acids • verification of Beer-Lambert's law • quality analysis (determination of Vitamin C, for example)	4h / practical
	Total	**60**

List of Text Books/ Reference Books

1	Practical Physical Chemistry – B.Viswanthan and P.S. Raghavan, 2005
2	Practical Physical Chemistry – Alexander Findlay, 1954

Course Outcomes (students will be able to….)

CO1	perform quantitative analysis of samples to determine purity / composition	K3
CO2	use common laboratory instruments with appropriate calibration and safety protocols	K3
CO3	apply concepts of equilibria and kinetics to determine properties of molecules / processes	K4
CO4	design experiments for acquiring physicochemical data and to interpret results for addressing specific queries / requirements	K4
CO5	Evaluate the results in terms of accuracy and estimated precision	K4
CO6	Identify the sources of errors and design steps to minimise the same	K5

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

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

CO6	3	3	3	2	1	2	3	2	2	2	2	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1
CO2	3	3	3	2	1
CO3	2	3	3	1	1
CO4	2	2	2	1	1
CO5	1	2	3	2	2
CO6	1	2	2	2	2

VSEC	Course Code: CHP1132	Course Title: Organic Chemistry Laboratory	Credits = 2		
			L	T	P
	Semester: II	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses
Standard XIIth Organic Chemistry Laboratory
List of Courses where this course will be prerequisite
Evaluation and Testing of Soaps and Detergents, Analysis of Surfactants
Description of relevance of this course in the B. Tech. Program
Students are introduced to basics of organic separations and identification of organic compounds based on their physicochemical properties. The course is relevant for training the students for working with binary mixtures. 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 b) Principles of quantitative separation of organic mixtures using physical properties, chemical properties and their combination	4 h each practical
2	a) Separation of solid-solid water insoluble binary organic mixtures b) Separation of solid-solid partly water soluble binary organic mixtures c) Separation of solid-solid mixtures by fractional crystallization d) Separation of liquid-liquid mixtures by distillation e) Separation of liquid-liquid mixtures by solvent extraction	
	Total	**60**

List of Textbooks/Reference Books	
1	Arthur, Vogel. Textbook of Practical Organic Chemistry, 5th edition, publishers Longman group Ltd, 1989
2	F.G. Mann and B.C. Saunders, Practical Organic Chemistry, 4th edition published by Orient Longman, 1974
3	Keese, R, Martin P. B, and Trevor P. Toube. Practical Organic Synthesis: A Student's Guide. John Wiley & Sons, 2006.

Course Outcomes (students will be able to….)		
CO1	understand basic principles for separation of binary organic mixtures qualitatively and quantitatively	K3
CO2	Estimate the components of binary mixtures quantitatively	K3
CO3	separate binary organic mixtures by multiple techniques and test the purity	K3
CO4	determine the purity of the individual components through quantitative analysis	K4
CO5	Design experimental protocols to improve the purity of isolated components	K5
CO6	Follow GLP protocols and work safely in the organic chemistry laboratory	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	1	1	2	1	1	2	2	1
CO2	2	2	2	3	1	1	2	1	1	2	2	2
CO3	1	2	3	3	1	2	2	2	1	1	1	2
CO4	2	2	3	2	1	2	2	3	3	3	2	2
CO5	3	3	3	2	1	2	3	2	2	2	2	2
CO6	3	3	3	2	1	2	2	2	2	2	2	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	1
CO2	3	3	3	2	1
CO3	2	3	3	1	1
CO4	2	2	2	1	1
CO5	2	2	2	1	2
CO6	2	2	3	3	2

CCA	Course Code:	Course Title: OPEN Activity - Sports/ Fine Arts/ Yoga/ Music/NSS**	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 60	0	0	4

List of Prerequisite Courses	

List of Courses where this course will be prerequisite

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

	Course Contents (Topics and subtopics)	Required Hours
1		15
2		15
3		15
	Total	60

List of Textbooks/ Reference Books	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Course Outcomes (students will be able to….)		
CO1		K2, K3
CO2		K1, K3
CO3		K2,
CO4		K2, K3
CO5		K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6

CO1						
CO2						
CO3						
CO4						
CO5						

	Course Code:	Course Title:	Credits =		
			L	T	P
	Semester: II	Total contact hours:	0	0	0

	List of Prerequisite Courses	
	List of Courses where this course will be prerequisite	
	Description of relevance of this course in the B. Tech. Program	
	Course Contents (Topics and subtopics)	Required Hours
1		
2		
3		
4		
5		
	Total	
	List of Textbooks/ Reference Books	
1		
2		
3		
4		
5		
6		
7		
8		
9		
	Course Outcomes (students will be able to….)	
CO1		K2, K3
CO2		K1, K2, K3
CO3		K2, K3, K5
CO4		K2, K3, K4
CO5		K3, K4, K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6

CO1						
CO2						
CO3						
CO4						
CO5						

SEMESTER – III

PCC	Course Code: OLT 1102	Course Title: SPL3:Chemistry of Oleochemicals and Surfactants	Credits = 4		
			L	T	P
	Semester: III	Total contact hours: 60	3	1	0

List of Prerequisite Courses

HSC (Science)

List of Courses where this course will be prerequisite

Analysis of Surfactants, Technology of Oil & Fat Production And Edible Oil Processing

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. 7th Ed. John Wiley and Sons, New York, (1987).
2.	Handbook of Surfactants, Porter, M. R., Springer Science and Business Media (1993).
3.	Surfactants in Consumer Products: Theory, Technology and Applications, Ed. J. Falbe, Springer-Verlag, Berlin (1987).
4.	Industrial Applications of Surfactants-II, 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), 4th 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, *John Wiley and Sons Ltd*, Chichester, UK (2004).

9	Richard M.; Marilyn E. K.; Pashley. Applied Colloid and Surface Chemistry, *John Wiley and Sons Ltd*, 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
CO4	Ability to identify and interpret the role of surfactants as specialty and high performance chemicals.	K5
CO5	Demonstrate understanding in surfactant chemistry and its application in alied field	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	1	2	2	2	2	2	2	2
CO2	3	2	3	2	2	2	2	2	3	2	1	2
CO3	3	2	2	3	2	2	2	2	2	2	2	2
CO4	2	3	3	2	2	2	2	2	2	3	2	1
CO5	3	2	2	3	2	2	2	2	2	2	2	2

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	3	2	3	2	2
CO3	2	3	2	2	2
CO4	2	2	3	2	2
CO5	2	3	2	2	2

ESC	**Course Code: OLT 1101**	**Course Title: SPL1: Chemistry of Oils and Fatty Acids**	**Credits = 2**		
			L	**T**	**P**
	Semester: I	**Total contact hours:30**	**1**	**1**	**0**

List of Prerequisite Courses
HSC (Science), Organic Chemistry I, Organic Chemistry II
List of Courses where this course will be prerequisite
Analysis of Surfactants, Technology of Oil & Fat Production And Edible Oil Processing
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. FereidoonShahidi, 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
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	1	2	2	1	3	3	3	1
CO2	3	3	2	2	2	2	2	2	3	3	2	2
CO3	3	2	1	2	1	2	2	2	3	3	2	1
CO4	2	2	3	3	2	2	2	2	2	3	2	2
CO5	2	2	3	2	3	2	2	2	3	3	2	2

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution, 0 – No contribution

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	2
CO2	2	3	2	2	2
CO3	3	2	2	2	2
CO4	3	2	2	2	2
CO5	2	3	2	2	2

	Course Code: HUT1205	Course Title: Basic Economics and Finance	Credits = L	T	P
	Semester: III	Total contact hours: 30	2	0	0

List of Prerequisite Courses

MATHS-1 AND MATHS -2 OF FIRST YEAR COURSEWORK

List of Courses where this course will be prerequisite

Chemical Process Economics(CET1805), Project-II

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

	Course Contents (Topics and subtopics)	Required 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 Antitrust Policy and Regulation	5
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
	Total	**30**

List of Textbooks/ Reference Books

1	Finance and Accounting for Nonfinancial Managers: All the Basics You Need to Know -William G. Droms and Jay O. Wright
2	Microeconomics: Basic Principles and Applications- A A Temu, D W Ndyetabula, et al
3	PRINCIPLES OF ECONOMICS(12e)- E. Case Karl, C. Fair Ray, et al

Course Outcomes (students will be able to….)

CO1	Students will be able to know and apply accounting and finance theory.	K3
CO2	Students will be able to understand the mechanics of preparation of financial statements, their analysis and interpretation	K2
CO3	Students will be able to explain basic economic terms, concepts, and theories	K2
CO4	Students will be able to identify key macroeconomic indicators	K3
CO5	Applying during the project cost calculation	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	1	1	2	2	2	1	1
CO2	2	2	2	2	2	1	2	1	2	2	1	0
CO3	2	1	2	2	1	1	2	1	1	1	1	2
CO4	2	2	2	2	2	3	1	2	2	2	1	1
CO5	2	2	2	2	2	2	2	2	2	2	1	1

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	1	2	2	3
CO2	0	1	2	2	3
CO3	0	1	2	2	3
CO4	0	1	1	2	3
CO5	2	2	1	2	2

	Course Code:	Course Title:	Credits =		
			L	T	P
	Semester: III	Total contact hours:	0	0	0

List of Prerequisite Courses	
List of Courses where this course will be prerequisite	
Description of relevance of this course in the B. Tech. Program	

	Course Contents (Topics and subtopics)	Required Hours
1		
2		
3		
4		
5		
	Total	

List of Textbooks/ Reference Books	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Course Outcomes (students will be able to….)	
CO1	K2, K3
CO2	K1, K2, K3
CO3	K2, K3, K5
CO4	K2, K3, K4
CO5	K3, K4, K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

CO3						
CO4						
CO5						

PCC	Course Code: OLP 1201	Course Title: Pr 1: Analysis of Oilseeds, Oils and Raw Materials of Oils and Soap Industry	Credits = 2		
			L	T	P
	Semester: III	Total contact hours: 60	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 Na2S2O3, 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 complexometeric 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 LovibondTintometer 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 byBockisch Michael

Course Outcomes (students will be able to….)		
CO1	Analyze and evaluate physical characteristics of oils like specific gravity, refractive index, color, viscosity etc.	K4
CO2	Evaluate properties of oils, fatty acids and oleochemicals like acid value, sap value, iodine value, oxidation, crystallization, oxirane value, amine value etc.	K5
CO3	Analysis of seeds, cakes and extractions, Detection of oils in mixtures, Vanaspati, margarine, ghee and waxes	K4
CO4	Analyze hardness of water in PPM by complexoeteric titration with EDTA	K4
CO5	Analysis by Advance analytical technique (GLC analysis) and separation of mixtures of oils by TLC	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	3	3	3	2	3	2	2
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	2	3	3	3	2	3	2	2
CO4	3	3	2	3	2	3	3	3	2	3	2	2
CO5	3	3	2	3	2	3	3	3	2	3	2	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	2
CO2	3	3	2	2	2
CO3	2	3	2	3	2
CO4	2	3	2	2	2
CO5	2	3	2	2	2

PCC	Course Code: OLP 1213	Course Title: Pr. 2: Preparation and Purification of Organic Derivatives	Credits = 2		
			L	T	P
	Semester: III	Total contact hours: 60	0	0	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 yieldof 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 *para*-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 *para*-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 *para*-toluic acid from *para*-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)	K3
CO2	Analyze purity of solid organic compounds via melting point determination. (K4)	K4
CO3	Learn and apply thin layer chromatography (TLC) techniques to calculate $R_f$values of unknown compounds. (K3)	K3
CO4	Demonstrate understanding of synthesis of different molecules	K4
CO5	Purification strategies for downstream processing	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	2	2	3	2	2
CO2	2	3	2	3	2	2	2	2	2	3	2	2
CO3	3	3	2	2	2	2	2	2	2	3	2	2
CO4	2	3	2	3	2	2	2	2	2	3	2	2
CO5	2	3	2	3	2	2	2	2	2	3	2	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	2
CO2	2	3	2	2	2
CO3	2	3	2	2	2
CO4	2	3	3	2	2
CO5	2	3	2	2	2

Semester-IV

PCC	Course Code: CET1105	Course Title: Transport Phenomena	Credits = 4		
			L	T	P
	Semester: IV	Total Contact Hours: 60	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 of fluids, 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 singe phase flow in a circular pipe	K2
CO2	Students will be able to select appropriate pump based on flow and head requirements	K3
CO3	Students should be able to calculate heat transfer coefficients and do basic sizing of double pipe and shell and tube heat exchangers	K3
CO4	Students should be able to perform preliminary sizing of phase change equipment such as reboilers and condensers	K3
CO5	Students should be able to calculate mass transfer coefficients and estimate mass transfer rates in simple situations	K3
CO6	Students should be able to understand empirical correlations and solve various equations analytically or numerically	K4

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1	1	1	1	1	3
CO2	3	3	2	3	2	1	2	1	1	1	1	3
CO3	3	3	3	3	3	1	2	2	2	1	1	3
CO4	3	3	3	3	3	1	1	1	2	1	1	3
CO5	3	3	2	3	2	1	1	1	1	1	1	3
CO6	3	3	2	3	3	1	1	1	1	1	1	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	3	3	2	2	3
CO3	2	2	2	1	3
CO4	3	2	2	3	3
CO5	3	2	1	2	1
CO6	3	3	1	2	2

PCC	Course Code: OLT 1111	Course Title:SPL5: Nutraceuticals	Credits = 3		
			L	T	P
	Semester: IV	Total contact hours: 45	2	1	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	Introdcution 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 able to….)		
CO1	Able to understand basics of nutraceuticals and regulatory issues (K2)	K2
CO2	Discuss about properties and functions of nutraceuticals (K4)	K4
CO3	Summaries on available technologies for manufacturing of nutraceuticals (K3)	K3
CO4	Evaluate the nutritional genomics and market information (K5)	K5
CO5	Discus on the applications, Consumers'views on nutraceuticals as well as Labeling and claims for Nutraceuticals products of perfumery chemicals (K4)	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	0	3	0	3	1
CO2	3	3	2	3	2	3	3	0	3	0	3	2
CO3	3	3	2	2	2	3	3	0	3	0	3	2
CO4	3	3	3	3	3	3	3	0	3	0	3	3
CO5	3	3	2	3	2	3	3	0	3	0	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	2
CO2	2	2	2	3	3
CO3	3	2	2	2	3
CO4	2	3	2	3	3
CO5	2	3	1	3	3

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. 5th 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 Schaerfer, B. Springer, **2014**.

Course Outcomes (students will be able to….)		
CO1	Understand the fundamental knowledge on perfumery chemicals (K2)	K2
CO2	Distinguish between terpenoids and non-terpenoids perfumery chemicals (K4)	K4
CO3	Apply the fundamental reactions for the synthesis of various aroma chemicals (K3)	K3
CO4	Apply the knowledge gained on various perfumery chemicals to the blending applications (K3)	K3
CO5	Understand Biosynthesis Pathways for different molecule synthesis	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	0	3	0	3	1
CO2	3	3	2	3	2	3	3	0	3	0	3	2
CO3	3	3	2	2	2	3	3	0	3	0	3	2
CO4	3	3	2	3	2	3	3	0	3	0	3	2
3	2	1	2	1	3	3	0	3	0	3	1	

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	3	2
CO2	3	2	1	3	3
CO3	2	1	2	3	3
CO4	3	3	2	3	3
CO5	2	1	2	3	3

EEM	Course Code: CET1805	Course Title: Chemical Process Economics	Credits = 2		
			L	T	P
	Semester: IV	Total contact hours: 30	2	0	0

List of Prerequisite Courses	
Process Calculations(CEP1720), Basics of Economics and Finance(HUT1205)	

List of Courses where this course will be prerequisite
nil

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)	Required Hours
1	Estimation of Plant and Machinery cost, Capacity Index, Cost Indices	8
2	Relationship between price of a product and project cost and cost of production, EV Analysis. Elements of cost of production, monitoring of the same in a plant, Meaning of Administrative expenses, sales expenses etc. Introduction to various components of project cost and their estimation. Project financing, debt: equity ratio, promoters, contributors, shareholders R	8
3	Project financing, debt: equity ratio, promoters, contributors, shareholders contribution, source of finance, time value of money. Concept of interest, time value of money, selection of various alternative equipment or system based on this concept. Indian norms, EMI calculations. Depreciation concept, Indian norms and their utility in estimate of working results of project. Working capital concept and its relevance to project.	8
4	Estimate of working results of proposed project. Capacity utilization, Gross profit, operating profit, profit before tax, Corporate tax, dividend, Net cash accruals. Project evaluation: Cumulative cash flow analysis Break-Even analysis, incremental analysis, various ratios analysis, Discounted cash flow analysis	6
5	Estimation of Plant and Machinery cost, Capacity Index, Cost Indices	8
	Total	**30**

List of Textbooks/ Reference Books	
1	Chemical Project Economics, MahajaniV.V.and Mokashi SM.
2	Plant Design and Economics for Chemical Engineers, Peters M.S.,TimmerhausK.D.
3	Process Plant and Equipment Cost Estimation, Kharbanda O.P.

Course Outcomes (students will be able to….)		
CO1	Calculate working capital requirement for a given project	K3
CO2	Calculate cost of equipment used in a plant total project cost	K3
CO3	Calculate cash-flow from a given project	K3
CO4	Select a site for the project from given alternatives	K4
CO5	List out various milestones related to project concept to commissioning	K2
CO6	Calculate overall profitability and rate of return for a given project	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	1	2	0	3	0	3	3
CO2	3	3	1	2	2	1	2	0	3	0	3	3

CO3	3	3	2	3	2	1	2	0	1	0	3	3
CO4	3	3	3	2	2	2	3	0	1	0	3	3
CO5	3	3	2	2	1	1	1	0	3	0	3	3
CO6	3	3	2	3	3	2	2	0	3	0	3	3

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	3
CO2	2	1	2	1	3
CO3	2	1	2	2	1
CO4	2	2	3	1	1
CO5	1	1	1	2	3
CO6	2	1	2	2	3

VEC	Course Code: HUT1206	Course Title: Environmental Science and Technology	Credits =2		
			L	T	P
	Semester: IV	Total Contact Hours: 30	1	1	0

List of Prerequisite Courses

Pharmaceutical Green Chemistry(PHT1418)

List of Courses where this course will be prerequisite

Project-II(PHP1449)

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

The course is very useful for the future Chemical Engineers and Technologists for assessing and appreciating impact of chemical processes and technologies on the Environment. The students will be exposed to the nitty-gritties of the impact of design principles on the Environment. Thorough understanding of these technology aspects is going to help in innovative solutions with positive impact on the environment.

	Course Contents (Topics and subtopics)	Required Hours
1	Introduction to all prevailing international standards of Health, Safety, and Environment (HSE); Environmental laws and regulations; Standards (air quality, noise, water), ISO14000+	3
2	Environmental impact assessment, Life cycle assessment (LCA)	3
3	Pollution prevention in chemical manufacturing, effluent valorization	2
4	Air pollution; Air pollutants: sources (specific pollutants), effects, and dispersion modelling, air pollution, air quality, pollutants minimisation and control, fugitive emissions (source and control), Noise pollution	4
5	Wastewater treatment; Groundwater and surface water pollution, removal of specific water contaminants; Solid waste; Hazardous waste	4
6	Inherent safety; Major disasters (e.g. Flixborough, UK; Bhopal, India; Seveso, Italy; Pasadena, Texas; Texas City, Texas; Jacksonville, Florida; Port Wentworth, Georgia)	5
7	Toxicology; Industrial hygiene	2
8	Source models; Toxic release and dispersion models	5
9	Fires and explosions; Concepts to prevent fires and explosions	3
10	Chemical reactivity	2
11	Reliefs and reliefs sizing; Hazard identification; Risk assessment	4
12	Safety procedures and designs	4
13	Some case histories	4
	Total	

List of Textbooks/ Reference Books

1	Environmental Studies by R. Rajagopalan, Oxford University Press.
2	Essentials of Environmental Studies by Kurian Joseph & Nagendran, Pearson
3	Education Renewable Energy by Godfrey Boyle, Oxford Publications
4	Perspective of Environmental Studies, by Kaushik and Kaushik, New Age
5	International Environmental Studies by. Anandita Basak, Pearson Education
6	Textbook of Environmental Studies by Dave and Katewa, Cengage Learning
7	Environmental Studies by Benny Joseph, Tata McGraw Hill
8	Textbook of Environmental studies by Erach Books Bharucha, University Press.
9	

Course Outcomes (students will be able to….)

CO1	Calculate BOD / COD for a given composition of effluent stream, estimation of biokinetics.	K3
CO2	Calculate adiabatic lapse rate and determine conditions for suitability of atmospheric dispersion, effective stack height, chimney design.	K3

CO3	Calculate concentrative of pollutant at any point in the neighbourhood of emission given atmospheric conditions like wind, dispersion, environmental factors, etc.	K3
CO4	Calculate size/time/power required for primary clarifier, secondary treatment, tertiary treatment, sizing of different types of Biological treatments etc.	K3
CO5	Identify hazards in a given process and assess the same and provide solutions for operating safely.	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	1	2
CO2	2	2	3	3	2
CO3	3	2	3	3	1
CO4	2	2	3	1	3
CO5	2	2	3	3	2

CEP/FP	Course Code: XXXXXXX	Course Title: Community Projects	Credits = 2		
			L	T	P
	Semester: IV	Total Contact Hours: 60	0	0	4

List of Prerequisite Courses	
NIL	

List of Courses where this course will be prerequisite
NIL

Description of relevance of this course in the B. Tech. Program
Students will explore the various community projects as individual or group related to study of societal technological activities through various organizations.

	Course Contents (Topics and subtopics)	Required Hours
1	Community service _ working with NGO Helping students in studies _ Making colorful charts _ short notes _ providing colouring books and colors _ Activity games _ Teaching street children _ Helping in school assignments _ Visiting old age homes and child care centre _ Good distribution Feeding them Playing games Play music and dance Show good movies _ Talk about Bharat Culture and Festivals Make some moral stories cartoon Design quiz and puzzles Live your childhood days with them	60
	Total	**60**

List of Textbooks/ Reference Books	
1	
2	
3	

Course Outcomes (students will be able to….)		
CO1		
CO2		
CO3		
CO4		
CO5		
CO6		K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

CO2												
CO3												
CO4												
CO5												
CO6												

Mapping of Course Outcomes (COs) with Programme Specific Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1					
CO2					
CO3					
CO4					
CO5					
CO6					

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 etc.	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) Separation of mixtures of surfactants: ion exchange, silica/ alumina columns/ TLC	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. Analysis of Detergents – including PO_4s, silicate, actives, enzymes, bleaches, polymers	5
		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)

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
CO1	3	2	1	2	1	3	3	0	3	0	3	1
CO2	3	3	2	3	2	3	3	0	3	0	3	2
CO3	3	3	3	3	3	3	3	0	3	0	3	3
CO4	3	3	3	3	3	3	3	0	3	0	3	3
CO5	3	3	2	3	2	3	3	0	3	0	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	2	3	3	3	3
CO3	3	3	3	3	3
CO4	2	3	2	3	3
CO5	3	3	3	3	3

	Course Code:	Course Title:	Credits =		
			L	T	P
	Semester: IV	Total contact hours:	0	0	0

List of Prerequisite Courses	

List of Courses where this course will be prerequisite

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

	Course Contents (Topics and subtopics)	Required Hours
1		
2		
3		
4		
5		
	Total	

List of Textbooks/ Reference Books	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Course Outcomes (students will be able to….)		
CO1		K2, K3
CO2		K1, K2, K3
CO3		K2, K3, K5
CO4		K2, K3, K4
CO5		K3, K4, K5

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

CO3						
CO4						
CO5						

Semester-V

PCC	Course Code: CET1806	Course Title: Chemical Reaction Engineering	Credits = 2		
			L	T	P
	Semester: V	Total contact hours: 30	1	1	0

List of Prerequisite Courses	
Physical Chemistry(CHT1405) , Process Calculations(CEP1720), Transport Phenomena(CET1105)	

List of Courses where this course will be prerequisite

Chemical engineering laboratory, Project-I & II, Processing of Oleochemicals& Waxes and Cosmetics Formulations

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 fibers, Foods, Dyes and intermediates, Oils, oleochemicals, and surfactants, Minerals, clean sing agents, Polymers and textiles, Biochemical and biotechnology, pharmaceuticals and drugs, Microelectronics, energy from conventional and non-conventional resources, Metals.

	Course Contents (Topics and subtopics)	Required 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/ Reference Books

1	Elements of Chemical Reaction Engineering – H.Scott Fogler
2	Heterogeneous Reactions, Vol.I and II –L.K. Doraiswamy, M.M.Sharma

Course Outcomes (students will be able to….)		
CO1	Estimate kinetics of chemical reaction based on laboratory data	K3
CO2	Derive design expressions for ideal reactor systems such as batch, plug flow and continuous stirred tank reactor	K3
CO3	Estimate conversion, yield and selectivity for different chemical reactions	K3
CO4	Compare various reactors and select an appropriate reactor for a given situation	K4
CO5	Select appropriate multiphase reactor based on reaction chemistry, heat and mass transfer aspects	K4
CO6	Identify rate controlling mechanism of a given reaction system involving mass transfer	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

CO4	3	3	3	3	2	1	3	1	1	1	1	3
CO5	3	3	3	3	1	2	1	1	2	1	1	3
CO6	3	3	3	3	2	1	1	1	2	1	1	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	2	2
CO2	1	2	3	2	2
CO3	1	2	3	2	2
CO4	1	1	3	2	2
CO5	3	1	2	1	3
CO6	3	2	1	1	3

PCC	Course Code: CET1807	Course Title: Chemical Engineering Operations	Credits =2		
			L	T	P
	Semester: V	Total contact hours: 30	1	1	0

List of Prerequisite Courses	
Process Calculations(CEP1720), Transport Phenomena(CET1105)	

List of Courses where this course will be prerequisite
Project-I , and Project-II

Description of relevance of this course in the B. Tech. Program
This is an applied Chem Engg. subject. The principles learnt in this course are required in this pharmaceutica technology courses and throughout the professional career of student

	Course Contents (Topics and subtopics)	Required 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 Textbooks/ 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….)		
CO1	Understand and compare various unit operations used in the chemical and allied industries	K3
CO2	Perform preliminary sizing of continuous and batch distillation columns	K3
CO3	Analyze filtration data and select systems based on requirements, estimate filtration area for given requirements, understand filter aids and their usage	K4
CO4	Construct ternary equilibrium diagram based on laboratory scale experimental data	K3
CO5	Understand the working principle of various industrial extraction, crystallization, filtration and drying equipment	K2
CO6	Select and carry out preliminary sizing of various industrial extraction, crystallization, filtration and drying equipment	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	1	1	1	2	1	1	3
CO2	3	2	3	3	2	2	1	2	2	1	1	3
CO3	3	3	3	2	2	1	1	2	2	1	1	3
CO4	3	3	2	2	3	1	1	2	2	1	1	3
CO5	3	2	2	2	1	1	1	1	2	1	1	3
CO6	3	3	2	2	3	2	2	2	2	1	1	3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	2	2
CO2	1	2	2	2	2
CO3	1	1	2	2	2
CO4	1	1	2	2	2
CO5	1	1	2	2	2
CO6	3	3	2	2	3

PCC	Course Code: OLT 1105	Course Title: SPL7: Technology of Oil and Fat Production and Edible Oil Processing	Credits = 4		
			L	T	P
	Semester: V	Total contact hours:60	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 ho
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….)		
CO1	Apply fundamental knowledge on basics of post harvest technology for oilseeds, chemistry involved in the oil /fat production and refining (K3)	K3
CO2	Understand plant and processes for oil/ fat extraction (K2)	K2
CO3	Evaluate the meal/ cake composition, and its upgradation by removal of antinutritional factors and detoxification (K5)	K5
CO4	Develop various fat modification processes (K3)	K3
CO5	Analyze composition and properties of fats, and fat products, and process development for its protection against auto oxidation (K4)	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	3	3	3	3	2
CO2	3	2	1	2	1	3	3	3	3	3	3	1
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	2	2	2	3	3	3	3	3	3	2
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1
CO2	2	2	3	2	1
CO3	2	2	2	2	2
CO4	2	2	3	1	2
CO5	3	3	3	2	2

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, 5th ed., Cengage learning, 2015.
2	P. S. Kalsi, Spectroscopy of Organic Compounds, 6thed, New age international publishers, 2007.
3	C. N. Banwell, Fundamentals of Molecular Spectroscopy, 3rd ed., TMH, New Delhi, 1983.
4	W. Kemp, Organic Spectroscopy, 3rd Ed., MacMillon, 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)	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)	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)	K3
CO4	Analyze structure of organic compounds via these advanced spectroscopic techniques. (K4)	K4
CO5	Demonstrate understanding of spectroscopyic technique for analysis of different molecules	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	2	2	2	3	2	2
CO2	3	2	1	2	2	2	2	2	2	3	2	1
CO3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	2	3	2	2	2	2	2	3	3	2
CO5	3	2	1	2	2	2	2	2	2	3	2	1

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	3	3
CO2	2	3	2	3	2
CO3	2	3	2	3	3
CO4	2	3	2	3	3
CO5	2	3	2	3	3

PCC	**Course Code: OLT 1114**	**Course Title: HONOR 1: Byproducts Utilization and Waste Management**	**Credits = 4**		
			L	**T**	**P**
	Semester: V	**Total contact hours: 60**	**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

Course Outcomes (students will be able to….)		
CO1	Understand basics of waste management	K2
CO2	Evaluate possible utilization and value addition to the byproducts	K5
CO3	Develop or synthesis of novel oleochemicals from waste streams/ byproducts	K3
CO4	Evaluate and design various techniques for waste water treatments and pollution control	K5
CO5	Summarise about technologies available for applications of byproducts	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	2	3	2	2	3	2	1
CO2	3	2	2	3	2	2	3	2	2	3	2	2
CO3	3	3	2	2	2	2	2	2	2	3	2	2
CO4	3	2	2	3	2	2	2	2	2	3	3	2
CO5	3	2	3	2	1	2	2	2	2	3	3	1

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO2	2	1	2	2	2
CO3	2	1	2	2	2
CO4	1	1	2	2	2
CO5	1	1	2	2	2

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)	K2
CO2	Selects appropriate processes for the extraction of essential oil (K3)	K3
CO3	Experiment on new techniques in production of essential oil.(K6)	K6
CO4	Perform analysis of essential oils (K4)	K4
CO5	Sensory analysis of products could be performed	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	2	2	2	3	3	1

CO2	3	2	2	3	2	2	2	2	2	3	3	2
CO3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	2	3	3	1	2	2	2	2	3	3	3
CO5	3	2	2	2	2	2	2	2	2	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	3
CO2	2	2	3	2	3
CO3	2	2	3	2	3
CO4	2	3	2	2	3
CO5	2	3	2	2	3

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 unsaponifable 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) Unsaponifable 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) Unsaponifable 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….)		
CO1	Interpret analysis of soaps and detergents(K3)	K3
CO2	Evaluate performance properties of soaps and detergents(K5)	K5
CO3	Able to explain the composition of soaps and detergents (K4)	K4
CO4	explain the significance of various tests for soaps and detergents(K5)	K5
Co5	Demonstrate Understanding of different analysis methods for soaps and detergents	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	2	2	3	2	2
CO2	3	2	2	3	1	2	2	2	2	3	2	3
CO3	2	2	2	3	2	2	2	2	2	3	2	2
CO4	2	3	3	3	3	2	2	2	2	3	2	3
CO5	2	2	2	3	2	2	2	2	2	3	2	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2
CO2	2	3	2	2	2
CO3	2	2	2	2	2
CO4	2	3	2	2	2
CO5	2	2	2	2	2

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 straightners.	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)

Course Outcomes (students will be able to….)		
CO1	Understand the basic formulation of cosmetics (K2)	K2
CO2	Selects the various ingredients and manufacturing processes for various cosmetics.(K4)	K4
CO3	Develop formulations of different cosmetics products (K3)	K3
CO4	Summarize stability analysis of cosmetic formulations . (K3)	K3
CO5	Demonstrate Understanding the of role of different ingredients in cosmetic formulation	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	3	3	3	3
CO5	3	2	3	3	3

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 ingredients for soaps.	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 21st 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 able to….)

CO1	Understand basics of soaps, surfactants and detergents (K2)	K2
CO2	Outline the plant and processes for soaps, surfactants and detergents (K4)	K4
CO3	Discuss upon raw materials and formulations of all types of surfactants for soaps and detergentsetc (K5)	K5
CO4	Interpret the effect of use of new generation of surfactants in formulation and comment on quality standards of soaps, surfactants and detergents(K3)	K3
CO5	Implement the use of surfactants in industrial applications(K3)	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	2
CO2	2	3	2	3	3
CO3	3	2	3	3	3
CO4	3	3	3	3	3
CO5	3	2	3	3	3

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 o 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)	K2
CO2	Interpret the logic behind the design of molecular building blocks towards the synthesis of varied self-assemblies including supramolecular polymers. (K3)	K3
CO3	Demonstrate various self-assembled architectures. (K3)	K3
CO4	Relate the effect of ligand structure to stabilize nanoparticles and self-assembly of nanoparticles. (K4)	K4

CO5	Utilize the acquired knowledge towards development of nano-technological devices. (K3)	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	2	3	2
CO2	1	2	3	3	3
CO3	2	1	3	3	3
CO4	2	1	3	3	3
CO5	3	2	3	3	3

PCC	**Course Code: OLT 1110**	**Course Title: SPl12 :Technology of Drying Oils and Resins**	**Credits = 4**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**3**	**1**	**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)	K2
CO2	Discus the types of drying Oils, resins and their applications (K4)	K4
CO3	Summarise about synthetic methods used for manufacture of alkyd resins (K3)	K3
CO4	Classify different types of resins and drying Oils on the basis of application and its properties . (K4)	K5
CO5	Demonstrate understanding of resins for respective applications	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	2
CO2	2	3	1	3	3
CO3	2	1	1	3	3
CO4	3	2	2	3	3
CO5	2	2	2	3	2

PCC	**Course Code:** OLT 1126	**Course Title:** Honors 2: Modern Analytical Techniques	**Credits = 4**		
			L	**T**	**P**
	Semester: VI	**Total contact hours:** 60	**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)	K2
CO2	Distinguish between various analytical and instrumental techniques (K4)	K4
CO3	Apply the fundamental knowledge for various oleochemicals (K3)	K3
CO4	Demonstrate understanding of analysis method for respective product propertie determination	K3
CO5	Will be able to explain different methods of analysis	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	2	2	3	1	1	2	3	1	1	3
CO5	3	2	1	2	1	3	3	3	3	3	3	1

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	2	3	3	1	1
CO5	2	2	3	1	1

VESC	Course Code: CEP1714	Course Title: Chemical Engineering Laboratory	Credits = 2		
			L	T	P
	Semester: VI	Total contact hours: 60	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

Chemical engineering laboratory, Project-I and Project-II

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

Chemical Engineering lab provides technology 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)	Required 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 Textbooks/ 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….)

CO1	Learn how to experimentally verify various theoretical principles	K3
CO2	Visualize practical implementation of chemical engineering equipment	K4
CO3	Perform statistical analysis of experimental data	K4
CO4	Get hands on experience with various measurement devices	K2
CO5	Develop empirical correlations based on the experimental data generated	K5
CO6	Generate meaningful tables and graphs	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	1	3	3	2	1	3
CO2	3	3	3	2	1	1	1	2	3	1	1	3
CO3	3	3	2	3	3	1	1	3	3	1	1	3
CO4	3	3	2	2	3	1	1	2	3	1	1	3
CO5	3	3	3	3	3	1	1	1	3	1	1	3
CO6	3	3	3	2	3	1	1	2	3	1	1	3

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

	PSO1	PSO2	PSO3	PSO4	PSO5

CO1	2	2	3	3	2
CO2	3	3	3	3	3
CO3	2	3	2	3	3
CO4	2	2	2	3	2
CO5	2	1	1	2	1
CO6	3	3	3	3	3

PCC	**Course Code: OLP 1202**	**Course Title: PR6:Processing of Oleochemicals & Waxes and Cosmetics Formulations**	**Credits = 2**		
			L	**T**	**P**
	Semester: VI	**Total contact hours: 60**	**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 21st 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 able to….)		
CO1	Apply synthesis knowledge for developing a oleochemical molecule (K3)	K2
CO2	Explain the reaction chemistry, for synthesis of various oleochemicals (K2)	K4
CO3	Evaluate properties and quality parameters of oleochemicals (K5)	K3
CO4	Create various cosmetics formulations (K6)	K5
CO5	Analyze the properties/ physical quality parameters and efficacy of cosmetics formulations (K4)	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	2	2	3	3

PCC	**Course Code:** OLP 1206	**Course Title: Pr4: Paint Technology Laboratory**	**Credits = 2**		
			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….)		
CO1	Understand fundamental knowledge on basics of chemistry involved in the Paints (K2)	K2
CO2	Classify different types of resins, Pigments and additives with respect to their properities and their applications (K4)	K4
CO3	Summaries methods used for manufacture for different paints. (K3)	K3

CO4	Discuss on different properties of paints on the basis of applications. . (K4)	K4
CO5	Able to Explain Process of paint production	K3
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	1	2	1	3	3	3	3	3	3	1

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	2
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	2	2	2	3	3
CO5	3	2	2	2	1

Semester-VII

PCC	**Course Code:** OLT 1115	**Course Title:** SPL13: Petroleum Technology	**Credits = 3**		
			L	**T**	**P**
	Semester: VII	**Total contact hours:** 45	**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 transportation	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 *Technology and Economics* (Fourth Edition) by James H. Gary and Glenn E. Handwerk
3	Refining processes Handbook by Surinderparkash

Course Outcomes (students will be able to….)		
CO1	Understand basics of crude oil, national and international scenario	K2
CO2	Summarise the processes for petroleum refining	K3
CO3	Summarise the plant and processes for petrochemicals	K3
CO4	Able to explain the key processes and products from petroleum	K3
CO5	Able to explain the various applications of petrochemicals	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	2	2
CO2	2	1	2	2	2
CO3	1	1	2	2	2
CO4	1	1	2	2	2
CO5	1	2	1	2	2

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) Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)
2	Treatise on fats, fatty acids and oleochemicals by O. P. Narula, Industrial Consultants (India), Vo. I & II (1994)
3	Recent advances in chemistry and technology of fats and oils by R. J. Hamilton, Elsevier Applied Science (1987)
4	Natural fatty acids and their sources by E. H. Pryde
5	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 21st 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)	K2
CO2	Select appropriate process for the manufacture of oleochemicals (K4)	K4
CO3	Summarise about advance method of analysis of oleochemicals. (K3)	K3
CO4	Select Specific method for the identification of particular oleochemical and understand its properties. (K4)	K4
CO5		
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	2	2	2	2	3	2	1
CO2	3	2	2	2	2	2	2	2	2	2	2	1
CO3	3	2	2	1	1	2	2	2	2	2	3	1
CO4	3	2	2	2	1	2	2	2	2	3	1	1
CO5	2	2	3	2	2	1	2	1	2	1	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2
CO2	3	2	3	2	2
CO3	2	2	3	2	2
CO4	2	2	2	2	2
CO5	2	2	3	2	2

PEC	Course Code: OLT 1119	Course Title: Dept Elective I: Product Management	Credits = 3		
			L	T	P
	Semester: VII	Total Contact Hours: 45	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 Startegy, 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)	K2
CO2	Identify market segment for a product (K3)	K3
CO3	explain strategies for a product to be effectively marketed(K2)	K2
CO4	Identify competitors for new product (K3)	K3
CO5	Understand importance of consumer market	
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

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

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	0	1	3	2	3
CO2	1	2	3	2	3
CO3	0	1	2	2	3
CO4	0	0	1	2	2

PEC	Course Code: OLT 1120	Course Title: Dept Elective II: New Product Development	Credits = 3		
			L	T	P
	Semester: VI	Total Contact Hours: 45	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 Deevelop 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 PDMAby 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 Kotleer, Kevin Lane Keller
6	Corporate Finanace, 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	K3
CO4	Define Criteria of new product Developent	K4
CO5	Product stability and viability testing	K4
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	2	3
CO2	0	1	1	2	3
CO3	0	1	1	2	3
CO4	2	3	3	3	3
CO5	1	2	2	2	2

	Course Code: OLT 1104	Course Title: Honors III: Chemistry of Essential Oils and their Applications	Credits = 3		
			L	T	P
	Semester: VII	Total Contact Hours: 45	2	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 Differentiate essential oil and coment on their physiochemical properties (K4)	K4
CO2	Able to Explain Characterization techniques for essential oil (K2)	K2
CO3	Select or identify advance method of analysis like GC, MS, HPLC, NMR (K4)	K4
CO4	Discuss novel process of extraction of essential oils from various natural sources and different types of Essential Oils. (K5)	K5
CO5	Understand the role of essential oil in various application K2	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

RM_ 1	Course Code: OLT1130	Course Title: Literature Review (Research Methodology-I)	Credits = 2		
			L	T	P
	Semester: VII	Total contact hours: 45	1	0	2

List of Prerequisite Courses

Communication Skills

List of Courses where this course will be prerequisite

Project-I and Project-II

Description of relevance of this course in the B. Tech. 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)	Required 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 (Gnatt 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
	Total	**45**

List of Textbooks/ Reference Books	
1	Menzel, D.; Writing a Technical Paper; McGraw-Hill, United States (1961).
2	Best, J. W., Kahn, J. V., Jha, A. K.; Research in Education; 10th ed.; Pearson, New Delhi, India (2005)
3	Davis R. M.; Thesis Projects in Science and Engineering: A Complete Guide from Problem Selection to Final Presentation; St. Martin's Press, (1980).
4	Anderson, J., Durston, B. H., Poole, M. E.; Thesis and Assignment Writing; John Wiley, United States (1970).
5	Menzel, D.; Writing a Technical Paper; McGraw-Hill, United States (1961).
6	Brown, L.; Effective Business Report Writing ; Prentice-Hall, United States (1973).
7	WIPO Intellectual Property Handbook; WIPO Publication (2004).
8	Carter, M.; Designing Science Presentations: A Visual Guide to Figures, Papers, Slides, Posters, and More; Academic Press, London (2013).
9	Ranganathan, S. R.; Documentation : Genesis and Development; Ess Ess Publications, India (2006).

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	K3
CO3	Understand and apply importance of literature survey in research design	K4
CO4	Understand an in-depth knowledge on the documentation in research	K5
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	K3
CO8	Create a model research project	K6

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	2	2	2	2	3
CO2	2	2	2	2	2	2	2	2	2	2	1	3
CO3	2	3	1	3	2	2	3	2	2	2	2	2
CO4	3	2	2	3	2	2	3	3	2	2	2	2
CO5	2	2	2	3	2	2	3	2	2	2	1	2
CO6	2	2	2	3	2	2	3	2	2	2	2	3
CO7	3	2	3	3	2	2	3	2	2	2	2	2
CO8	2	2	2	3	2	2	3	2	2	2	2	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	2	2	2	3	3
CO3	3	2	2	3	3
CO4	2	2	2	3	3
CO5	2	2	2	3	3
CO6	2	2	3	3	3
CO7	1	1	2	3	3
CO8	3	2	2	3	3

RM-II	Course Code: OLP1219	Course Title: Design and Analysis of Experiments (Research Methodology – II)	Credits =2		
			L	T	P
	Semester: VII	Total contact hours: 45	0	0	0

List of Prerequisite Courses

Engineering Mathematics, Process Calculations

List of Courses where this course will be prerequisite

This course is required for graduating students to function effectively in Industry, Academia and other professional spheres. Project-II(PHP1449)

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 rigor 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 organizations, 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)	Required 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 2k 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
	Total	**45**

List of Textbooks/ Reference Books

1	Douglas C. Montgomery, Design and Analysis of Experiments, 8th 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 GebhardtOptimal 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….)		
CO1	Students should be able to understand basic principles of design of experiments.	K3
CO2	Students should be able to perform statistical analysis of single experiments and do post hoc analysis.	K4
CO3	Students should be able to conduct experiment and analyse the data using statistical methods.	K5
CO4	Students should be able to choose an appropriate design given the research problem.	K4
CO5	Students should be able to perform statistical analysis of different designs using R and interpret the results.	K5
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	0	3	3	3	3	3	3	1
CO2	3	2	2	2	2	3	3	3	1	2	3	2
CO3	3	3	2	2	1	1	3	3	3	3	3	2
CO4	3	3	2	2	2	3	0	2	3	3	3	2
CO5	3	2	2	0	2	3	3	3	1	3	0	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	3	3
CO2	1	3	1	2	3
CO3	1	3	2	2	3
CO4	1	1	3	3	3
CO5	0	2	1	1	3

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	K5
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
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

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

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

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

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	3
CO2	3	2	1	2	3
CO3	2	3	2	2	3
CO4	0	1	1	1	3
CO5	2	2	1	1	3

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 amphoterric 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). Study experiments on phosphate esters, multifunctional additives and greases.	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 21st 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….)		
CO1	Classify raw materials for soap formulation and its analysis (K4)	K4
CO2	outline the synthesis of various types of surfactants (K4)	K4
CO3	Develop detergent formulation and its analysis (K6)	K6

CO4	summaries on application of surfactants for various home and personal care products (K3)	K3
CO5	explain the various testing methods for lubricants (K2)	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	2	2
CO2	3	1	2	2	3
CO3	2	3	2	2	3
CO4	3	2	2	2	3
CO5	2	3	2	2	3

Semester-VIII

PCC	**Course Code: OLT**	**Course Title:SPL15: Functional Fluids and Performance Chemicals**	**Credits = 3**		
			L	**T**	**P**
	Semester: VIII	**Total contact hours: 45**	**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, polygleycerol and MEG based), manufacturing process, properties.	5
	Total	**45**

List of Text Books/ Reference Books	
1	Lubricants and Lubrication Edited by Theo Mang and WilfriedDresel
2	Lubricants and special fluid by Vaclav stgpina and Vaclav Vesely
3	Chemistry and Technology of Lubricants Edited by Roy M. MortierMalcolm F. Fox and Stefan T. Orszulik

Course Outcomes (students will be able to….)		
CO1	Understand basics of lubricants and functional fluids (K2)	K2
CO2	Evaluate properties and functions of various types of base oils (petroleum and biobased) (K5)	K5
CO3	Summaries about methods of synthesis and analyze properties of performance chemicals (K3)	K3
CO4	Explain and evaluate the various properties and applications of functional fluids and performance chemicals (K5)	K5
CO5	Apply technology for regeneration of waste lube oil, engine coolants and greases (K3)	K3

K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	3	2
CO2	2	1	2	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

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

List of Prerequisite Courses
Chemistry of oleochemcials 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**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; − No Contributio

Course Outcomes (students will be able to….)		
CO1	Understand the fundamental knowledge on various energy sources (K2)	K2
CO2	Explaining different derivatization techniques of fuels (K4)	K4
CO3	Apply the fundamental knowledge for various applications of fuels (K3)	K3
CO4	Will be able to identify alternative oil sources for biodiesel formation	K3
CO5	Will be able to expllain synthethic route for synthesis of biodiesel	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	2	3	2	3	3	3	3	3	3	2	2	3
CO5	2	1	3	3	2	1	1	1	1	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	3	2

CO2	2	2	1	3	3
CO3	3	2	3	3	3
CO4	3	2	2	2	2
CO5	2	1	2	2	2

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	Understand Various Characterization Techniques	K3
CO4	Understand role of biopolymers in various applications	K2
CO5	Will be able to able differentiate between different biopolymer chemistry	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	3	2
CO2	1	3	1	3	3

CO3	1	2	3	3	3
CO4	1	3	1	3	3
CO5	1	2	3	3	3

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

List of Prerequisite Courses
Project – I , All oleochemical subjects
List of Courses where this course will be prerequisite
Professional Career and future academic research
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…..)

Course Outcomes (students will be able to….)		
CO1	Perform experiments & troubleshoot to generate reliable data (K5)	K5
CO2	Apply different statistical tools for scientific data analysis (K4)	K4
CO3	Evaluate critically the experimental data and draw meaningful inferences (K5)	K5
CO4	Develop skills to communicate the research outcome effectively (K6)	K6
CO5	Develop skills for writing a complete document on the project work (K6)	K6
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	3	3	2
CO2	2	3	3	3	3
CO3	2	3	3	3	3
CO4	2	3	3	3	3
CO5	2	3	3	3	3

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 WilfriedDresel
2	Lubricants and special fluid by Vaclav stgpina and Vaclav Vesely
3	Chemistry and Technology of Lubricants Edited by Roy M. MortierMalcolm 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 Outcomes (students will be able to….)		
CO1	Classify lubricants (K4)	K4
CO2	Synthesis of biobased fluids (K4)	K4
CO3	Develop lubricant formulation and its analysis (K6)	K6
CO4	Summaries the application of functional fluids for various applications (K3)	K3
CO5	explain the various testing methods for lubricants (K2)	K2
K1 – Remembering, K2 – Understanding, K3 – Applying, K4 – Analyzing, K5 – Evaluating, K6 – Creating		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	3	3	3	3	3	3	1
CO2	3	3	2	3	2	3	3	3	3	3	3	2
CO3	3	3	2	2	2	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3	2

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)					
	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2
CO2	2	3	3	3	3
CO3	2	2	2	3	3
CO4	1	2	2	3	3
CO5	3	3	3	3	3

<table>
<tr><td rowspan="2"></td><td>Course Code:</td><td>Course Title:
Internship with Industry</td><td colspan="3">Credits = 12</td></tr>
<tr><td></td><td></td><td>L</td><td>T</td><td>P</td></tr>
<tr><td></td><td>Semester: VIII</td><td>Total Contact Weeks: 12-16</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">List of Prerequisite Courses</td></tr>
<tr><td colspan="6">None</td></tr>
<tr><td colspan="6">List of Courses where this course will be prerequisite</td></tr>
<tr><td colspan="6">Project – I , Project – II</td></tr>
<tr><td colspan="6">Description of relevance of this course in the B. Tech. Program</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td></td><td colspan="4">Course Contents (Topics and Subtopics)</td><td>Required Weeks</td></tr>
<tr><td>1</td><td colspan="4">In the Eighth semester, every student will have to undergo an internship and/or On Job Training. The Internship would be of 12 credits.
1. The internship would be assigned to the student by the Departmental Internship Coordinator, with the approval of Head of the Department.
2. 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.
3. The internship could be of the following forms:
4. Industrial internship in a company (within India or Abroad) involved in R&D / Project design / manufacturing (QA/QC/Plant Engineering/Stores and Purchase) / marketing / finance / consultancy / Technical services / Engineering/Technology / Projects, etc.
5. 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.
6. 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 Department of Pharmaceutical Sciences and Technology.
7. 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.</td><td>12</td></tr>
<tr><td></td><td colspan="4">Total</td><td>12</td></tr>
</table>

F. Scheme of Evaluation of Internship with Industry (SEMESTER – VIII)

PROGRAM ELECTIVES

HONORS